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ECONOMIC FACTORS IN MARKETING FARMERS' CASTORBEAN'S

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The study on which this report is based was made under authority of the Agricultural Marketing Act of 1946.

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CONTENTS

Page

Summary 1
Background and purpose of study 2
Samples and data used 3
Varieties of castorbeans raised under programs 3
Castorbeans delivered under program, 1951-54 3
The hulling process 4
Grading and pricing castorbeans under program, 1951-54 4
    Foreign material 7
    Cracked and broken beans 7
    Moisture 8
    Relationships between grade factors 9
Analysis of oil content of castorbeans 9
    Relationship of oil content to dryland and irrigated areas 10
    Relationship of oil content to cracked and broken beans 12
    Relationship of oil content to unhulled beans 13
Experiments on storage of castorbeans 14
    Oil content through 2 years' storage 16
    Chemical analysis of oil from beans in storage 16
    Moisture content of beans in storage 21
Appendix 26

Tables Page

1. Analysis of variations in grade factors of farmers' lots of Conner variety castorbeans. United States, by State and hulling center, 1951 crop 4
2. Analysis of variation in grade factors of farmers' lots of castorbeans, United States, by variety and State, 1952 crop 5
3. Analysis of variation in grade factors of farmers' lots of castorbeans, United States, by variety and State, 1953 crop 6
4. Differential in value of oil recovered from the high and low oil content varieties of castorbeans, crops of 1951-54 6
5. Characteristics of castorbeans as shown by field and laboratory analyses, by variety and crop year, 1951-54 10
6. Variation in oil content of castorbeans, grown on dry or irrigated land by variety and crop year, for 3 States and United States, 1951-53 crops 11
7. Characteristics of castorbeans as shown by field and laboratory analyses, by State and variety, 1951 crop 12
8. Characteristics of castorbeans grown on dryland or under irrigation, as determined by field and laboratory analyses, by State and variety, 1952 crop 13
9. Characteristics of castorbeans grown on dryland or under irrigation, as determined by field and laboratory analyses, by State and variety, 1953 crop 14
10. Characteristics of castorbeans grown on dryland or under irrigation, as determined by field and laboratory analyses, by State and variety, 1954 crop 15
11. Difference between hulling centers in castorbeans of lowest oil content and of highest oil content, by variety, 1952-53 season 15
12. Relationships between moisture content of castorbeans and temperature, precipitation, and relative humidity during storage at Whitesboro, Texas, 1953 and 1954 25

Page

13. Characteristics of castorbeans as shown by field and laboratory analyses, by variety and hulling center, 1951 crop........ 26
14. Characteristics of castorbeans, dryland and irrigated, as shown by field and laboratory analyses, by variety and hulling center 1952 crop........ 27
15. Characteristics of castorbeans, dryland and irrigated, as shown by field and laboratory analyses, by variety and hulling center, 1953 crop........ 29
16. Characteristics of castorbeans, dryland and irrigated, as shown by field and laboratory analyses, by variety and hulling center, 1954 crop........ 32
17. Chemical analysis of samples of Conner variety castorbeans and of the oil extracted from them, the beans having been taken from storage at Whitesboro, Texas, 1953 and 1954........ 33
18. Chemical analysis of whole and of cracked and broken castorbeans and of the oil extracted from them, by storage center and variety, 1952 crop........ 35
19. Analysis of variation in grade factors of farmers' lots of castorbeans, by variety and State, 1951-54 crops........ 36
20. Analysis of variation in grade factors of farmers' lots of Conner castorbeans, by hulling center, 1951-53........ 37
21. Analysis of variation in grade factors of farmers' lots of castorbeans, by variety and hulling center, 1952 and 1953 crops........ 37
22. Grade factors of farmers' lots of castorbeans, by variety and hulling center, 1954 crop........ 38
23. Grade factors of farmers' lots of castorbeans, dryland or irrigated, by variety and hulling center, 1953 crop........ 40
24. Grade factors of farmers' lots of castorbeans, by variety and hulling center, 1952 crop........ 41
25. Production of castorbeans, by State, 1951-54 crops........ 42
26. Acreage and yield of castorbeans, United States, 1951-54 crops........ 43
27. Average weight per bushel of castorbeans, dryland and irrigated, by State, 1951-54 crops........ 43
28. Average weight per bushel of castorbeans, dryland and irrigated, by variety, 1951-54 crops........ 43
29. Acreage, production, and yield of castorbeans under irrigation in the southern plains of Texas, by county, 1952 crop........ 43
30. Castor oil mill operations, United States, by month through 3 operating seasons, August 1951 through July 1954........ 44
31. Castorbeans: Production in specified countries and the world, averages 1935-39 and 1945-49, annual 1950-54........ 45
32. Relationship between oil content of castorbeans and quantity of cracked and broken beans, by variety and hulling center, 1952 and 1953 crops........ 46
33. Relationship between quantity of cracked and broken castorbeans and moisture content, by variety and hulling center, 1952 and 1953 crops........ 46
34. Relationship between quantity of unhulled castorbeans and moisture content, by variety and hulling center, 1952 and 1953 crops........ 46

Economic Factors in
MARKETING FARMERS' CASTORBEANS

By George W. Kromer, Agricultural Economist

SUMMARY

Under present marketing practices, the castorbean farmer is not paid for his castorbeans according to the value of oil and pomace they will yield. The value depends principally on the oil content of the castorbeans. But, because the farmer is not paid on an oil-content basis, he is more interested in growing beans with high yields per acre than beans with high oil content.

Four points stand out in the results of the study: (1) No justification was found for docking the farmer for cracked and broken castorbeans, (2) oil content of different varieties of castorbeans showed significant differences, (3) the price the farmer received for his castorbeans did not vary with the expected worth of the products, and (4) castorbeans stored for 2 years still maintained their commercial grade.

During the domestic castorbean program for the 4 crops of 1951-54, castorbeans were graded by Commodity Credit Corporation on the basis of foreign material, cracked and broken beans, and moisture content. The average dockage for these 3 factors during the period was 4.63, 1.82, 1.88, and 2.95 percent, respectively.

Foreign material was the most frequent cause for dockage, and was the least stable of the factors. Two-thirds of all foreign material was attached to the castorbeans, but free foreign material varied more in amount than did the attached. Lots of beans from irrigated areas averaged slightly higher in foreign material than did beans from dryland areas, mainly because of larger amounts of free foreign material.

Cracked and broken castorbeans in farmers' lots for the 4 seasons averaged 3.33, 4.65, 3.93, and 5.56 percent, respectively. The relative variation from these averages was 49, 42, 51, and 57 percent, respectively.

Moisture content was the most stable of the grade factors in the 4 crops, averaging 6.01, 5.56, 5.70, and 5.64 percent, respectively. The relative variation was 20, 14, 17, and 20 percent, respectively. Moisture content had a positive relationship with cracked and broken beans (0 to 0.73) as well as with unhulled beans (0 to 0.85) at individual hulling centers. Moisture explained as much as 53 percent of the variation in cracked and broken beans and 72 percent in unhulled beans, at some hulling centers. A 1-percent change in moisture accompanied a median change of 1.5 percent in cracked and broken and 1.4 percent in unhulled beans. This analysis was carried out by variety, and these relationships held true for each variety, and for all geographical areas, whether dryland or irrigated.

Average oil content for all varieties of castorbeans, on a clean, moisture-free basis, was 54.4, 53.7, 53.3, and 53.8 percent for the 4 seasons. The relative variation in oil content from these averages was 3.4, 4.3, 3.9, and 3.7 percent. Castorbeans grown under irrigation varied about 1 percent more in oil content than did dryland beans.

Important differences in oil content were found between varieties. The Cimarron was the variety with the highest oil content in 2 seasons. For the crops of 1952 and 1953 it averaged 55.5 and 54.7 percent, respectively. This was approximately 1.5 percent more oil than the Conner variety contained. For 1951 and 1954 the Cimarron and Conner showed 54.5 and 54.4 percent, respectively. The variety with the lowest oil content in each of the 4 seasons was a variety grown under irrigation. In 1951 it was the Baker 7, averaging 52.1 percent; in 1952, a hybrid at 49.4 percent; in 1953, Baker 195 at 49.3 percent; and in 1954, a hybrid at 51.7 percent. The Cimarron grown on dryland in 1952 and 1953 averaged 55.2 and 54.9 percent of oil, whereas the same variety under irrigation averaged 56.6 and 54.1 percent, respectively. The variety with the highest oil content averaged in the 4 crops 4.6, 12.3, 11, and 5.2 percent more oil than the variety with the lowest oil content. In pounds of oil per ton of beans, the differences were 48, 122, 108, and 54 pounds. The economic differential amounted, per ton, to $15.64, $33.64, $23.69, and $8.84.

Oil content of castorbeans correlated positively with the quantity of cracked and broken beans. The degree of association varied considerably but the relationship existed

for the main varieties. The Conner variety showed the highest relationship, ranging from zero to 0.80.

Castorbeans store well. Both whole and cracked and broken castorbeans that had been in storage 2 years yielded oil that met National Stockpile Specifications for No. 1 castor oil. The oil from cracked and broken beans was slightly lower in quality than that from whole beans with respect to free fatty acid. However, the cracked and broken beans yielded 9 percent more oil than whole sound beans, because some of the seedcoat, which contains only about 2 percent of oil, is lost when beans are broken. In similar tests involving different areas and varieties of castorbeans, the cracked and broken beans contained 11.5 percent more oil.

Specific gravity of the oils from whole beans and from cracked and broken beans each averaged 0.962 during the 2 years of storage. The average Gardner color number of the oil from both whole beans and cracked and broken was 3--maximum for No. 1 oil. Free fatty acid content during the first year of storage was relatively stable, averaging 0.32 percent for oil extracted from whole beans and 0.38 percent for cracked and broken. In the second year of storage, free fatty acid content of oil from whole beans remained at about its original level, averaging 0.35 percent, although there was a slight increase in the last quarter. The oil from cracked and broken beans in the second year of storage deteriorated slightly as the free fatty acid averaged 0.72 percent. While free fatty acid nearly doubled the second year, the oil still met specifications for No. 1 oil. Iodine number of the oil from both whole beans and cracked and broken beans averaged 86, which met No. 1 oil specifications. Unsaponifiable matter in the oil from both whole beans and cracked and broken beans increased slightly during the 2 years of storage but remained within the maximum for No. 1 oil.

Castorbeans seem to absorb moisture in the cold months of storage and lose moisture in the hot months. This seasonal variation is partially explained by temperature, precipitation, and relative humidity. These 3 factors combined account for about 40 percent of the variation, temperature being the more important. Cracked and broken beans during the 2-year storage experiment averaged 0.5 percent less moisture than whole beans.

BACKGROUND AND PURPOSE OF STUDY

Few castorbeans were grown commercially in the United States before 1950, and in that year when castor oil was classified by the Office of Defense Mobilization as one of the 6 strategic oils, Brazil was the source of approximately 90 percent of our supply. A domestic castorbean production and procurement program was initiated by the U. S. Department of Agriculture with the crop of 1951 and was continued through the 1954-55 season. No program was available for the 1955 crop.

The primary purpose of the program, which was carried out by the Commodity Credit Corporation, was to increase the supply of castor oil for current industrial uses in connection with military and essential civilian needs, and to make additional quantities of oil available for the strategic stockpile. The program was also intended to aid growers in developing experience with castorbeans so that production could be expanded readily in case of emergency.

The program was made available to farmers entering into contracts with CCC, with private companies, or with cooperative associations, in areas within States designated by CCC and for which adapted planting seed was available. Acreages harvested in the 4 years of the program were 63,000, 98,000, 125,000, and 26,000. The 4 crops yielded 8, 12, 23, and 4.5 million pounds of castor oil, respectively.

Yield of castorbeans per acre increased significantly during the operation of the program. Excluding Arkansas, the percentage of increase ranged from 50 in Arizona to 181 in Texas. The greatest gain in yield per acre was in California, where castorbeans are grown on irrigated land; the yield increased from 756 pounds in 1951 to 1,442 in 1953. Factors contributing to the increased yields were: (1) Shifts to land better adapted to castorbeans, (2) improved varieties of seed, (3) improved harvesting methods, and (4) increased experience in growing castorbeans.

The U. S. average yield per acre, 1951 to 1954, was 332, 252, 412, and 448 pounds. The decrease in yield from 1951 to 1952 reflects a substantial shift from the irrigated areas of California and Arizona to the lower-yielding dryland areas of Texas and Oklahoma.

Castorbeans are grown for the most part in the Southwestern States: Arkansas, Arizona, California, Missouri, New Mexico, Oklahoma, and Texas, largely in semiarid areas. The marketing season ordinarily begins late in July and runs through mid-February, but varies somewhat between varieties and between dryland and irrigated areas. Harvesting usually begins earlier in the dryland areas, where the beans are handpicked, than in the irrigated areas, where the beans are harvested by combines and stripper harvesters. Furthermore, harvesting on dryland extends over a longer time, mainly because there are several pickings.

Information sought in this economic study included answers to these questions: (1) What influence do variety, climate, irrigation, moisture content, and foreign material have on outturn value of castorbeans? (2) Is the practice of docking farmers for cracked and broken beans justified? (3) Is the oil from cracked and broken beans of the same value as oil from whole sound beans? (4) How long may castorbeans be stored and maintain their quality? (5) How does storage affect castorbeans as related to outturn of products?

SAMPLES AND DATA USED

The basic data for the study were derived primarily from 3 series of samples: (1) Composite samples from each farmer's lot as delivered to Commodity Credit Corporation in the programs of 1951-52 through 1954-55. These samples were analyzed for the 3 factors which formed the basis of the price paid by CCC during the programs: foreign material, cracked and broken beans, and moisture. (2) A random selection from these samples, the oil content of which was measured. (3) Samples taken from castorbeans in storage, the oil content of which was measured; an analysis of the oil was made also.

VARIETIES OF CASTORBEANS RAISED UNDER PROGRAMS

Commercial castorbean varieties in the 4 crops, 1951-54, included Conner, Cimarron, U. S. 74, Baker 1, Baker 7, Baker 195, and hybrids. Only Conner was restricted to dryland production. The Conner grows relatively tall and is harvested by hand, usually requiring several pickings throughout the season. In terms of commercial production, the Conner was the most important variety during the 4 years of the domestic castorbean program.

The Cimarron and U. S. 74 varieties, which are intermediate in plant growth, were grown both on dryland and under irrigation. In areas where these varieties were grown under irrigation they were harvested by combines whereas in dryland areas they were handpicked.

The Baker 1, Baker 7, Baker 195, and hybrids, all of which are dwarf varieties, were grown only under irrigation and were harvested either by stripper harvesters or combines.

CASTORBEANS DELIVERED UNDER PROGRAM, 1951-54

Each grower contracting with CCC was required to deliver his beans in hulls to the hulling plant. The beans belonging to each grower were hulled, weighed, sampled, and inspected separately. Farmers delivered 2,072 lots of beans during the 1951-52 marketing season totaling 1.5 million gross pounds or an average of 717 pounds per lot.[1] In the 1952-53 season, the number of deliveries increased to 15,966, for a total of 18.2 million gross pounds or an average of 1,137 pounds per lot. The number of individual deliveries declined in the 1953-54 season to 12,751 but the total quantity of castorbeans increased to 18.9 million pounds. The average lot, therefore, increased to 1,481 pounds. In 1954-55, farmers delivered 3,777 lots totaling 10.7 million pounds, or an average of 2,831 pounds.

The average size of farmers' individual loads varied considerably. In general, loads from irrigated acreages are substantially larger than those from drylands. For example, during the 1953-54 marketing season, the average lot of Baker 1 beans from irrigated areas of Texas was 10,866 pounds whereas the U. S. 74 beans from dryland areas of Texas averaged 895 pounds. This variation in size of loads largely reflects differences in harvesting techniques, yields per acre, and size of farm.

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[1] The data in this section on the number of farmers' lots and the quantity of castorbeans delivered represent that portion of the crop for which CCC records were available. For the crops 1951 through 1954, the quantity of beans delivered represented approximately 7, 74, 37, and 100 percent, respectively, of domestic castorbean production.

THE HULLING PROCESS

Hulling plants remove and separate the hulls and trash from the beans. The beans are moved by a pneumatic system from the farmer's load to the huller. Some beans may be cracked or broken before they enter the hulling machines if they are carried too fast and back up in the unloader.

The hullers are designed to handle mature dry beans--beans with less than 6 percent of moisture. If the farmer has harvested his beans under moist conditions or before they are thoroughly ripe, it may be necessary to pre-dry them before a satisfactory job of hulling can be done. The hulls are highly hygroscopic, absorbing moisture in light precipitation or high humidity. Damp beans are hulled slowly, and many are cracked, broken, or left unhulled.

The hulling plants were not designed to recirculate unhulled beans, and if the operator finds too many of them he adjusts the discs for less clearance. This hulls more beans but the number of cracked and broken may be larger.

Some beans are damaged when blown from the huller through metal pipes and also from their impact against the floor or walls of bins or against beans in storage.

GRADING AND PRICING CASTORBEANS UNDER PROGRAM, 1951-54

As more information on the marketing of castorbeans became available during the program, slight revisions were made whereby the farmer received a price more in line with the quality of his beans. No premiums were awarded, but discounts were made when the beans did not meet specified standards. The three factors for which discounts were made were amounts of free and attached foreign material, of cracked and broken beans, and moisture content of beans.

The average deduction during the 1951-52 marketing season took 4.63 percent from the gross weight of the farmers' castorbeans, the largest of the 3 years (table 1). The coefficient of variation was 93 percent.[2] The 1951 crop was small due primarily to adverse weather and to excessive shattering near the end of the season. Much of the stand in Oklahoma and Texas was so poor it would not have been harvested except for the failure of other crops and the need of cash income. The average dockage of castorbeans in Oklahoma was 5.45 percent as compared with 3.69 in Texas. The large amount of foreign material was the major reason for this dockage.

During the 1952-53 and 1953-54 seasons the average grading deduction was about the same--1.82 and 1.88 percent, respectively. The coefficient of variation was 95 percent in 1952-53 and 83 percent in 1953-54 (tables 2 and 3). In 1954-55, the average grading deduction was 2.95 percent and the relative variation 83 percent. Despite drought and early frost in Texas and Oklahoma, yields in 1952 averaged higher than the year before. In

TABLE 1.--Analysis of variation in grade factors of farmers' lots of Conner variety castorbeans, United States, by State and hulling center, 1951 crop

Hulling center	Marketing period		Farmers' lots hulled			Free foreign material		Attached foreign material		Total foreign material		Cracked and broken beans		Moisture		Grading deduction	
	From	To	Number	Weight[1]		Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]
				Total	Average												
				Pounds	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Oklahoma:																	
Ardmore.......	8-22	1-15	227	125,082	551	1.31	75	2.07	66	3.34	123	3.37	9	5.62	13	3.47	52
Henryetta.....	9-11	1-4	599	449,698	751	.99	141	4.28	73	5.29	62	3.88	43	6.41	26	6.10	56
Ripley........	9-13	12-31	280	224,981	804	2.04	60	3.08	54	5.04	47	3.38	53	6.52	13	5.68	44
Total.......	8-22	1-15	1,106	799,761	723	1.33	102	3.52	76	4.83	60	3.64	42	6.37	22	5.45	57
Texas:																	
Brownwood.....	9-13	1-11	402	230,938	574	3.42	228	1.92	60	5.32	140	2.64	33	5.35	17	5.20	144
Pecos.........	11-8	12-17	44	192,794	4,382	.91	70	1.10	53	2.01	44	2.10	70	5.30	7	1.68	53
Stephenville..	9-14	1-16	520	261,537	503	1.03	127	1.45	61	2.47	60	3.30	62	6.00	14	2.70	10
Total.......	9-13	1-16	966	685,269	709	2.02	261	1.61	64	3.64	140	2.97	57	5.70	16	3.69	136
Total U. S..	8-22	1-16	2,072	1,485,030	717	1.65	227	2.64	86	4.27	97	3.33	49	6.06	20	4.63	93

[1] Gross pounds delivered before grading deduction.
[2] Coefficient of variation.

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[2] Coefficient of variation is a relative measure of dispersion. It equals the standard deviation of a variable expressed as a percentage of its average. Its advantage lies in the fact that it can be used to compare the variation of several factors and areas, whereas a comparison of the standard deviation alone of these factors and areas would be meaningless.

TABLE 2.—Analysis of variation in grade factors of farmers' lots of castorbeans, U. S., by variety and State, 1952 crop

Variety and state	Marketing period		Farmers' lots hulled			Free foreign material		Attached foreign material		Total foreign material		Cracked and broken beans		Moisture		Grading deduction	
	From	To	Number	Weight[1]		Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]
				Total	Average												
Conner				*Pounds*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Oklahoma.......	8-19	2-9	2,933	2,683,544	915	.70	179	1.65	70	2.36	77	5.20	27	5.33	11	2.36	80
Texas..........	7-25	1-31	11,326	9,334,027	824	.41	183	1.22	72	1.63	77	4.70	41	5.68	13	1.65	95
U.S.-Conner..	7-25	2-9	14,259	12,017,571	843	.47	189	1.31	73	1.78	80	4.80	38	5.60	14	1.79	94
Baker 1																	
Oklahoma.......	9-3	10-6	2	5,190	2,595	1.55	([3])	1.10	([3])	2.65	([3])	3.60	([3])	4.80	([3])	2.30	([3])
Texas..........	8-1	1-31	945	4,623,921	4,893	1.48	97	.93	87	2.41	73	3.03	70	5.08	15	2.09	86
U.S.-Baker 1.	8-1	1-31	947	4,629,111	4,888	1.48	97	.93	87	2.41	73	3.03	70	5.08	15	2.09	86
Cimarron																	
Arkansas.......	11-1	1-16	60	199,677	3,328	.23	113	1.84	59	2.07	56	3.01	39	5.37	23	1.84	86
Oklahoma.......	8-27	1-30	155	254,407	1,641	1.26	121	1.23	65	2.48	81	4.97	57	5.34	28	2.43	92
Texas..........	9-23	2-13	94	416,442	4,430	1.97	160	1.34	99	3.32	112	5.69	71	5.08	47	3.42	122
U.S.-Cimarron	8-27	2-13	309	870,526	2,817	1.27	169	1.38	78	2.66	97	4.81	66	5.28	33	2.62	112
U. S. 74																	
Oklahoma.......	8-18	1-30	421	564,147	1,340	.77	160	1.02	65	1.79	80	3.17	45	5.68	15	1.53	101
Texas..........	9-1	1-15	23	29,045	1,263	1.29	109	.97	65	2.26	67	3.14	35	5.16	9	1.87	80
U.S.-74......	8-18	1-30	444	593,192	1,336	.80	155	1.02	65	1.81	80	3.17	44	5.65	14	1.55	100
Baker 7																	
Texas-U.S......	10-22	12-6	7	46,242	6,606	2.40	52	1.07	88	3.47	52	5.13	43	5.06	11	3.43	62
All varieties																	
United States..	7-25	2-13	15,966	18,156,642	1,137	.56	180	1.28	74	1.84	81	4.65	42	5.56	14	1.82	95
All varieties																	
Arkansas.......	11-1	1-16	60	199,677	3,328	.23	113	1.84	59	2.07	56	3.01	39	5.37	23	1.84	86
Oklahoma.......	8-18	2-9	3,511	3,507,288	999	.74	170	1.56	71	2.29	79	4.95	33	5.35	13	2.26	83
Texas..........	7-25	2-13	12,395	14,449,677	1,166	.51	182	1.20	73	1.70	81	4.58	43	5.62	14	1.70	96
United States	7-25	2-13	15,966	18,156,642	1,137	.56	180	1.28	74	1.84	81	4.65	42	5.56	14	1.82	95

[1] Gross pounds delivered before grading deduction.
[2] Coefficient of variation.
[3] Too few lots to compute variation.

1953 growing conditions were as good as or better than those in 1952. In general, castorbeans coming from irrigated areas were docked slightly more throughout the program than those from dryland areas, due primarily to larger amounts of foreign material. Oklahoma areas on the average were docked the most for the crop of 1952--2.26 percent; in 1953, New Mexico irrigated areas were penalized the most--2.86 percent, and in 1954, Arkansas areas were docked the most--3.52 percent.

The price paid farmers by CCC for the 1951 and 1952 crops produced under the program was 10 cents per pound, hulled basis, or the market price at the time and place of delivery, whichever was higher. The minimum guarantee for the 1953 crop was 9 cents per pound; for 1954, 6 cents per pound. Each year the farmer received one-half cent less per pound when CCC rendered the hulling service.

The value of castorbeans depends on the quantities of oil and pomace which they yield, and the prices obtainable for each. The oil is the more valuable product. Castor pomace, the residue after the extraction of the oil, is used as an organic fertilizer for it contains appreciable amounts of nitrogen, phosphorus, and potash.

The present method of grading does not take into account the oil content; consequently, the producer has been more interested in growing varieties with high yields per acre than those with high oil content. Trading on an oil-content basis would provide the farmer with a financial incentive to produce beans of high oil content. If a rapid method of determining the oil content of individual lots could be developed, it would be a stride toward an equitable manner of evaluating castorbeans. Without such method, the farmer is relatively underpaid for beans with high oil content, and overpaid for those with low. The economic differential in beans high and low in oil content is shown in table 4. In terms of castor oil per ton of beans, the difference was 48 pounds in 1951, 122 pounds in 1952, 108 pounds in 1953, and 54 pounds in 1954. Assuming a 95 percent rate of oil recovery and using average annual prices of castor oil, tanks, f.o.b. New Jersey mills, the differential per ton was \$15.64, \$33.64, \$23.69, and \$8.84, respectively.[3] A pound of castor oil in 1954 was selling for one-half as much as in 1951 (17 and 34 cents).

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[3] The differential would be slightly less if an allowance were made for the quantity and value of the pomace. Also, the differential would be greater if the recovery rate were 99.5 percent which some processors are able to obtain.

TABLE 3.--Analysis of variation in grade factors of farmers' lots of castorbeans, U. S., by variety and State, 1953 crop

Variety and State	Marketing period		Farmers' lots hulled			Free foreign material		Attached foreign material		Total foreign material		Cracked and broken beans		Moisture		Grading deduction	
	From	To	Number	Weight[1]		Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]
				Total	Average												
				Pounds	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Conner																	
Oklahoma.......	8-25	1-30	3,748	3,926,288	1,048	0.41	168	1.08	69	1.49	72	4.27	35	5.87	13	1.85	70
Texas..........	8-13	1-29	4,341	4,112,018	947	.51	212	1.07	66	1.58	97	4.42	40	5.47	19	1.89	91
Texas (Irrigated)	11-30	1-5	35	262,009	7,486	2.00	133	1.75	63	3.76	83	5.08	61	4.42	10	4.29	90
U.S.-Conner..	8-13	1-30	8,124	8,300,315	1,022	.47	200	1.08	68	1.55	88	4.36	38	5.65	17	1.88	84
Cimarron																	
Arkansas.......	10-8	3-5	219	358,287	1,636	.37	95	.77	81	1.15	65	2.96	41	6.03	16	1.50	77
Oklahoma.......	8-26	1-6	1,404	2,301,387	1,639	.49	147	.90	111	1.38	106	3.11	45	6.19	11	1.76	94
Texas..........	8-18	1-11	214	208,605	975	.22	136	1.11	137	1.33	65	3.75	55	5.66	18	1.71	92
Texas (Irrigated)	7-20	1-18	179	1,686,670	9,423	1.11	108	.91	104	2.02	86	3.40	45	5.13	15	2.18	91
New Mexico (Irrigated)	10-31	12-23	47	122,455	2,605	1.01	139	1.83	52	2.86	63	4.87	30	5.65	04	3.06	60
U.S.-Cimarron	7-20	3-5	2,063	4,677,404	2,267	.52	148	.93	102	1.44	99	3.23	46	6.01	14	1.80	90
U. S. 74																	
Oklahoma.......	8-27	1-8	1,927	2,102,203	1,091	.49	133	1.04	71	1.52	66	2.92	99	5.69	22	1.68	71
Texas..........	8-13	1-22	103	92,192	895	.22	118	1.52	64	1.73	60	2.10	51	5.56	16	1.91	56
New Mexico (Irrigated)	10-23	12-10	270	1,040,370	3,853	.91	107	1.63	54	2.54	57	4.96	31	5.59	08	2.78	52
U. S. 74.....	8-13	1-22	2,300	3,234,765	1,406	.52	137	1.13	71	1.65	68	3.13	89	5.67	21	1.82	70
Hybrid 4																	
Texas..........	8-21	9-8	6	3,591	599	.17	59	.50	40	.67	39	4.05	18	6.70	08	1.43	43
New Mexico (Irrigated)	10-30	12-16	17	55,470	3,263	.76	84	2.28	54	3.05	48	7.18	31	5.60	07	3.52	43
U. S. Hybrid.	8-21	12-16	23	59,061	2,568	.61	100	1.82	73	2.43	67	6.36	38	5.89	11	2.97	56
Baker 1																	
Texas (Irrigated)	7-8	12-10	241	2,618,639	10,866	1.33	138	1.43	84	2.76	82	3.20	51	5.08	13	2.91	84
All varieties																	
United States..	7-8	1-30	12,751	18,890,184	1,481	.50	182	1.07	76	1.57	87	3.93	51	5.70	17	1.88	83
All varieties																	
Arkansas.......	10-8	3-5	219	358,287	1,636	.37	95	.77	81	1.15	65	2.96	41	6.03	16	1.50	77
New Mexico (Irrigated)	10-23	12-16	334	1,218,295	3,648	.92	111	1.69	55	2.61	58	5.06	32	5.60	07	2.86	53
Oklahoma.......	8-25	1-30	7,079	8,329,878	1,177	.45	153	1.03	79	1.48	77	3.68	55	5.89	16	1.79	75
Texas..........	8-13	1-29	4,664	4,416,406	947	.53	209	1.10	68	1.63	96	4.28	43	5.48	18	1.93	91
Texas (Irrigated)	7-8	1-18	455	4,567,318	10,038	1.26	205	1.05	97	2.31	91	3.67	54	5.05	16	2.53	99
United States	7-8	1-30	12,751	18,890,184	1,481	.50	182	1.07	76	1.57	87	3.93	51	5.70	17	1.88	83

[1] Gross pounds delivered before grading deductions.
[2] Coefficient of variation.

TABLE 4.--Differential in value of oil recovered from the high and low oil content varieties of castorbeans, crops of 1951-54

Crop and variety	Oil content per ton		Oil recovered per ton		
	Percentage[1]	Quantity	Price per lb.[2]	Quantity[3]	Value[4]
	Percent	*Pounds*	*Cents*	*Pounds*	*Dollars*
1951					
Cimarron....................	54.5	1,090	34	1,036	352.24
Baker 7....................	52.1	1,042	34	990	336.60
Difference....................	2.4	48	34	46	15.64
1952					
Cimarron....................	55.5	1,110	29	1,055	305.95
Hybrid....................	49.4	988	29	939	272.31
Difference....................	6.1	122	29	116	33.64
1953					
Cimarron....................	54.7	1,094	23	1,039	238.97
Baker 195....................	49.3	986	23	936	215.28
Difference....................	5.4	108	23	103	23.69
1954.					
Cimarron....................	54.4	1,088	17	1,034	175.78
Hybrid 4....................	51.7	1,034	17	982	166.94
Difference....................	2.7	54	17	52	8.84

[1] Clean moisture-free basis.
[2] Average annual price of castor oil per pound, tanks, f.o.b. New Jersey Mills, New York Journal of Commerce.
[3] Based on 95 per cent recovery rate which screw press mills average. Some hydraulic-solvent extraction processors are able to recover up to 99.5 per cent of the oil in the beans.
[4] Value slightly higher for hydraulic-solvent extraction mills because less oil is left in the pomace.

Foreign Material

Under the grading methods used for the crops of 1951 and 1952, farmers were docked for foreign material in excess of one-half of 1 percent. Beginning with the crop of 1953, no foreign material was permitted. Handling of foreign material is wasteful; the material not only contains no oil, but absorbs oil during the extraction process. It also imparts an objectionable dark color to the oil.

Foreign material may be either free or attached. Free foreign material includes hulls, stems, rocks, grass, weeds, cockleburs, sticks, dry and unripe capsules and capsule segments both filled and unfilled, "poppers," etc. Attached foreign material includes hulls and spikes on mature sound beans.

Total foreign material for the four crops 1951-54, averaged 4.27, 1.84, 1.57, and 2.40 percent, respectively. The most substantial decrease in average foreign material was from 1951 to 1952--a 57 percent reduction. Beside the fact that the beans were grown under slightly more favorable weather conditions, the improvement in quality also reflects the increasing "know-how" on the part of producers, shifts to areas better adapted to castorbeans, and a fuller realization by farmers of the dockage for foreign material. The coefficient of variation for the 4 crops was 97, 81, 87, and 86 percent, respectively. Foreign material was the least stable of the grade factors in each of the 4 seasons.

Approximately two-thirds of total foreign material consists of the attached type. For the 4 crops, 1951-54, the actual percentage that attached foreign material represented of total foreign material was 62, 69, 68, and 55, respectively. There is considerably more variation, however, in free foreign material than in the attached type. The coefficient of variation in free foreign material for the 1951 crop was 227 percent compared with 86 percent in attached foreign material. In 1952, comparable data were 180 percent and 74 percent, respectively, in 1953, 182 percent and 76 percent, respectively, and in 1954, 144 percent and 81 percent, respectively.

The relative stability in the dispersion of attached foreign material for the 4 crops together with the reduction in free foreign materials suggests that farmers may have a greater degree of control over the amounts of free foreign material than attached foreign material. The farmer has an opportunity to decrease his costs by delivering cleaner loads of castorbeans. He should further benefit insofar as clean beans increase the efficiency of the hulling plant.

Lots of castorbeans coming from irrigated areas averaged higher in foreign material than beans from dryland acreages. For example, during the 1953-54 season, castorbeans from the dryland areas of Texas averaged 1.63 percent of foreign material as compared with 2.31 percent from Texas irrigated areas. While attached foreign material was approximately the same in both instances, 1.10 and 1.05 percent, respectively, free foreign material was about 0.75 percent greater in beans from irrigated areas. Castorbeans grown in irrigated areas are harvested by combines and stripper harvesters. This method of harvesting evidently gathers more free foreign material than does handpicking.

Among the States, castorbeans hulled in Oklahoma averaged highest in foreign material for 2 seasons--4.83 percent in 1951 and 2.29 percent in 1952, whereas in 1953 beans from Texas irrigated areas averaged 2.31 percent. The best record for one season was made by Arkansas farmers who delivered the cleanest lots of beans in 1953, averaging 1.15 percent of total foreign material. Furthermore, the coefficient of variation was among the lowest--65 percent. In 1954, however, Arkansas lots of castorbeans averaged highest in foreign material--2.84 percent. The relative variation remained at 65 percent.

Cracked and Broken Beans

Undoubtedly the most controversial of the grade factors used in the domestic program was cracked and broken beans. The seed coat of the castorbean contains less than 2 percent of oil, and when the beans are cracked and broken, part or all of the seed coat is lost. The remaining part of the bean consequently shows a higher percentage of oil. Castorbeans may become cracked and broken in the hulling process or in transit. Processors have asserted that cracked and broken beans are objectionable because they lose oil, collect dust, and in time become rancid.

In 1951, a maximum of 2 percent of cracked and broken beans was allowed, with one-third of the percentage above 2 being deducted from the gross weight. In 1952, the maximum allowance for cracked and broken beans was increased to 3 percent with one-fifth of the percentage above 3 being deducted from the gross weight. In 1953 and 1954, the maximum percentage remained the same but only one-tenth of the percentage above 3 was deducted.

The average load of castorbeans contained 3.33 percent of cracked and broken beans in 1951, 4.65 in 1952, 3.93 in 1953, and 5.56 in 1954. The coefficient of variation was 49, 42, 51, and 57 percent respectively. Only moisture content was relatively more stable than cracked and broken beans.

In 1951, farmers' deliveries in Oklahoma averaged 3.64 percent of cracked and broken beans as compared with 2.97 percent in Texas. Relative variation, however, was somewhat higher in Texas (57 percent) than in Oklahoma (42 percent). In 1952 the States ranked the same except on a higher level.

In 1953-54, Arkansas farmers delivered loads of castorbeans averaging 2.96 percent of cracked and broken beans. On the other hand, farmers delivering beans from the irrigated areas of New Mexico averaged highest in percentage of cracked and broken beans--5.06 percent. Relative variation, however, was 41 percent in Arkansas as compared with 32 percent in New Mexico.

In 1954-55, all the States averaged higher in cracked and broken castorbeans than in any of the 3 earlier crops. The averages varied from 4.86 percent in Texas to 5.53 percent in Arkansas. The coefficient of variation was 54 and 61 percent, respectively.

The data do not clearly demonstrate that castorbeans grown in irrigated areas consistently have a larger proportion of cracked and broken beans than do those in dryland areas. For example, in Texas during the 1953-54 marketing season, the average load of castorbeans from irrigated areas yielded 3.67 percent of cracked and broken beans whereas the average for dryland farming areas was 4.28 percent. Relative variation was 54 percent and 43 percent, respectively.

In each of the 4 seasons the average lot of castorbeans contained from 0.9 percent to 2.6 percent of cracked and broken beans in excess of the maximum permitted.

Moisture

Moisture content of castorbeans varies with rainfall, temperature, length of growing season, and type of farming area. Moisture content, nevertheless, was the most stable of the grade factors during the crop years 1951-52 through 1954-55.

Castorbeans are harvested shortly after the first killing frost or after artificial defoliation, when the plant has dried somewhat. If harvest is delayed, the yield may be lower owing to loss from shattering or dropping.

Marketable castorbeans were permitted to have 6 percent of moisture in each of the 4 years of the program, 1951-52 through 1954-55. Such allowance is customary, of course, with most oilseeds and grains that are marketed in a similar manner. It is less equitable than the handling of foreign material, however, in its failure to evaluate each lot delivered on its value content. The weight of moisture above 6 percent was deducted from the gross weight of the farmer's lot. Average moisture content of all farmers' deliveries during the 1951-52 season was 6.06 percent, in comparison with 5.56 percent in 1952-53, 5.70 percent in 1953-54 and 5.64 percent in 1954-55. The coefficient of variation was 20, 14, 17, and 20 percent respectively. Oklahoma farmers' wagonloads averaged 6.37 percent of moisture content in 1951-52, whereas the average for Texas was 5.70 percent. The coefficient of variation was 22 percent and 16 percent, respectively.

During the 1952-53 season, average moisture content was fairly uniform among the States. It was 5.37 percent in Arkansas, 5.35 percent in Oklahoma, and 5.62 in Texas. Relative variation was greatest in Arkansas (23 percent), whereas in Oklahoma (13 percent) and Texas (14 percent) it was approximately the same. Castorbeans produced under irrigation averaged about 0.5 percent less moisture than those produced on dryland. There were, however, no significant differences in the coefficients of variation.

In the 1953-54 season, average moisture content of farmers' deliveries was highest in Arkansas (6.03 percent) and lowest in Texas irrigated areas (5.05 percent). The coefficient of variation, however, was the same in both instances--16 percent. Castorbeans grown under irrigation averaged slightly less in moisture content than those from the dryland areas. Furthermore, moisture content of irrigated beans showed slightly less scatter about the average. For example, the coefficient of variation of beans from irrigated areas of Texas was 16 percent as compared with the beans from Texas dryland areas of 18 percent.

During the 1954-55 season, average moisture content was highest for Arkansas (6.21 percent) and lowest for New Mexico (4.84 percent). Relative variation was 13 and 10 percent, respectively.

Relationships Between Grade Factors

The relationships between the factors by which the beans were graded--foreign material, cracked and broken beans, and moisture content--were investigated with regard to variety of castorbeans, geographical area, and dryland or irrigated farming. It is a common assumption that the three grade factors are interrelated. Samples of beans were collected and analyzed to test this assumption.

Of the 70 hulling centers for which analysis was made of the relationship of moisture content to cracked and broken castorbeans, and to unhulled beans, scatter diagrams seemed to show some consistency of relationship in 14 centers for each. Relationship in the remaining 56 in each case appeared to be essentially zero. In most of those showing correlation, the number of samples was too small to indicate statistical significance individually. Taken together, however, their appreciable consistency lends some credence.

The coefficients of correlation for the relationship between cracked and broken beans and moisture content ranged among the 14 centers analyzed from 0.13 at Grand Saline, Tex., to 0.73 at Rush Springs, Okla.[4] The most probable change in cracked and broken beans with each 1-percent change in moisture content, as shown by these data, ranged from 0.17 to 4.5 percent.[5] In one case moisture content explained as much as 53 percent of the variance in cracked and broken beans.[6]

For the relationship between unhulled castorbeans and moisture content, the coefficients of correlation ranged from 0.05 at Athens, Tex., to 0.85 at San Antonio, Tex. The median coefficient of correlation for the Conner variety was 0.41. A 1-percent change in moisture content of the castorbeans was associated with a 1.4 percent median change in unhulled beans. Moisture content in one case explained as much as 72 percent of the variance in unhulled beans. There seems to be no indication that these relationships of moisture to cracked and broken beans and unhulled beans depends preponderantly on any one of the three factors--variety, location, or type of farming (irrigation vs. dryland). Also, there remains unexplained a rather wide variation in the percentages of cracked and broken beans.

In some grains a relationship has been found between foreign material and moisture content, apparently because immature weed seeds and other moist plant materials are included. Results of analysis at 10 hulling centers operating in 1952 did not indicate, however, any significant relationship between foreign material and moisture content. In 4 of the 10 centers the relationship between foreign matter and moisture appeared to be slightly positive; however, the scatter was too great to estimate a trend line reliably. In each of the four hulling centers the slight relationship was for a different variety of castorbean.

The relationship between foreign material and cracked and broken beans was studied because some persons in the industry are of the opinion that foreign material in castorbeans will cause damage in the hulling process. Analysis of 10 centers operating in 1952-53 showed no such relationship. In only 1 of the 10 centers there appeared a slight positive relationship but the scatter was too great for the results to be reliable.

ANALYSIS OF OIL CONTENT OF CASTORBEANS

Samples of farmers' individual loads were drawn at the hulling centers during the marketing period for each of the 4 crops, 1951-54. Random selections of these samples were sent to the Beltsville, Md., laboratory in airtight containers where they were analyzed for foreign material, moisture, and oil content. The official test methods of the American Oil Chemists' Society were used.

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[4] Coefficient of correlation measures the degree of relationship when one variable is associated with another variable. Perfect relationship between the variables would be 1.

[5] Coefficient of regression measures the number of units of change in the dependent variable which is associated with a change of one unit in the independent variable. The measurement is determined from the fitted trend (regression) line as computed by the method of least squares.

[6] Coefficient of determination is the square of the coefficient of correlation. It measures the percentage of variation explained in the dependent variable when associated with one or more independent variables.

The average oil content of all the varieties, on a clean, moisture-free basis, was 54.4 percent for the 1951 crop, 53.7 for 1952, 53.3 for 1953, and 53.8 for 1954 (table 5). The coefficients of variation were 3.4 percent, 4.3 percent, 3.9 percent, and 3.7 percent, respectively.

The Cimarron variety had the highest oil content for 2 seasons. For the crops of 1952 and 1953 it averaged approximately 1.5 percent more oil than the Conner variety. In both 1951 and 1954 the Cimarron and Conner yielded the same percentage of oil. The Conner is strictly a dryland variety whereas the Cimarron is grown in both dryland and irrigated areas.

The variety with the lowest oil content in each of the 4 seasons was an irrigated variety. In 1951 it was the Baker 7, averaging 52.1 percent; in 1952 the Hybrid at 49.4 percent; in 1953 Baker 195 at 49.3; and in 1954 the Hybrid 4 at 51.7. In other words, the variety with the highest oil content contained on the average 4.6, 12.3, 11, and 5.2 percent more oil in these 4 years than the variety with the lowest oil content.

Oil content cannot be given proper consideration in the grading of castorbeans merely by basing premiums and discounts on varietal differences. Oil content varies not only between varieties but also within varieties. To illustrate: the coefficient of variation in oil content of the dryland Cimarrons for the crops of 1952 and 1953 was 3 percent. Although the Cimarron averaged highest in oil content, there were some lots that were no higher in oil content than some of the other varieties.

Relationship of Oil Content to Dryland and Irrigated Areas

It is questionable whether the difference in oil content of the samples from dryland and irrigated areas was significant. For example, the Cimarron grown on dryland in

TABLE 5.--Characteristics of castorbeans as shown by field and laboratory analyses, by variety and crop year, 1951-54

Variety	Sample	Field analysis				Laboratory analysis				
		Moisture[1]	Free foreign material	Unhulled beans	Cracked and broken beans	Foreign material	Moisture (clean sample)[1]	Oil		Nitrogen
								Clean moisture free	Whole sample	Moisture free and oil free
					1951					
	Number	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Cimarron	14	5.2	1.1	6.7	6.1	2.6	5.6	54.5	--	6.5
Conner	125	5.6	1.1	8.3	5.3	1.9	5.6	54.5	--	6.6
U. S. 74	31	5.6	0.7	4.1	4.1	1.0	5.5	54.2	--	6.5
Baker 7	5	4.4	1.0	1.8	7.3	1.5	5.0	52.1	--	6.7
All varieties	175	5.6	1.0	7.4	5.2	1.8	5.6	54.4	--	6.6
					1952					
Cimarron	169	5.2	0.7	5.3	3.7	1.8	5.6	55.5	51.4	--
U. S. 74	103	5.6	0.8	4.7	3.6	1.6	5.7	54.1	50.2	--
Baker 7	9	5.2	3.6	5.2	5.0	4.6	5.6	54.0	48.5	--
Conner	265	5.5	0.4	4.9	5.2	1.6	5.7	53.7	49.8	--
Baker 1	164	4.9	1.2	3.7	3.1	1.7	5.3	51.7	48.1	--
Baker 195	20	5.1	1.6	4.0	2.7	1.9	5.5	51.7	47.9	--
Hybrid	3	5.5	2.1	3.2	9.5	2.5	5.6	49.4	45.5	--
All varieties	733	5.3	0.8	4.7	4.1	1.7	5.6	53.7	49.8	--
					1953					
Cimarron	160	5.4	0.5	4.6	4.6	1.4	5.8	54.7	50.8	--
Mixed	7	5.9	0.9	3.3	5.2	1.3	6.6	54.4	48.8	--
Conner	282	5.7	0.4	3.9	5.5	1.3	6.0	53.4	49.5	--
U S 74	97	5.6	0.2	5.0	3.3	1.1	6.4	51.5	47.5	--
Hybrid 4	15	5.5	0.6	4.1	4.4	1.3	5.6	50.7	47.2	--
Baker 1	22	5.4	0.6	6.3	2.8	1.8	5.8	50.6	46.8	--
Baker 195	2	5.5	0.8	4.0	4.0	1.3	5.8	49.3	45.8	--
All varieties	585	5.6	0.4	4.4	4.8	1.3	6.0	53.3	49.3	--
					1954					
Cimarron	70	5.3	0.7	4.9	5.4	2.0	5.1	54.4	50.5	--
Conner	63	5.1	0.3	4.5	6.9	1.6	6.0	54.4	50.3	--
Hybrid 7	20	4.9	1.5	4.5	6.0	2.5	5.1	53.1	49.1	--
Mixed	8	3.7	1.4	4.6	4.6	2.0	4.2	52.8	49.6	--
Baker	11	3.5	0.9	8.3	3.4	2.6	4.7	52.1	48.4	--
Hybrid 4	11	4.8	0.8	2.6	5.0	1.3	5.0	51.7	48.5	--
All varieties	183	5.0	0.7	4.8	5.8	1.9	5.4	53.8	50.0	--

[1] Differences in moisture content as determined in the field and laboratory are primarily due to method of analyses.

1952 and 1953 averaged 55.2 percent and 54.9 percent of oil, whereas the same variety grown under irrigation averaged 56.6 percent and 54.1 percent, respectively.

For the 3 crops 1951 through 1953, the coefficient of variation in oil content of castorbeans grown under irrigation was 4.8 percent as compared with 3.8 percent for beans grown on dryland (table 6). The combined relative variation was 4.1 percent.

Among individual States, Texas averaged 54.6 percent of oil for the 1951 crop as compared with 54.2 percent for Oklahoma (table 7). Arkansas, where the Cimarron was the only variety grown commercially, ranked highest in oil content for 1952 and 1953, averaging 55.7 and 55.5 percent. Furthermore, oil content varied relatively less in Arkansas than in any other dryland State.

Castorbeans grown under irrigation in 1952 averaged 49.7 percent in oil content in Arizona and 50.7 percent in California, the lowest 2 States that year (table 8). The Bakers and Hybrids were the main varieties grown in these States. During the same season, the average oil content of all varieties in Oklahoma was 54.4 percent as compared with 53.2 percent in Texas. Castorbeans grown on dryland in Oklahoma averaged about 1 percent more oil than the dryland beans from Texas, whereas the irrigated varieties in Oklahoma averaged about 1.5 percent more oil than Texas irrigated beans.

For the belt as a whole, the average oil content of castorbeans grown on dryland in 1952 was 54.1 percent as compared with 52.6 percent for beans under irrigation, a difference of questionable significance. For the 1953 crop, the oil content of samples of castorbeans from dryland areas averaged 53.3 percent in comparison with 53.2 percent for irrigated beans (table 9). For the crop of 1954, oil content of dryland castorbeans averaged 54.1 percent whereas irrigated beans averaged 53.0 percent.

Oklahoma dryland varieties averaged 52.9 percent in oil content for the crop of 1953 while Texas dryland varieties averaged 53.3 percent. Irrigated varieties in New Mexico averaged 55.6 percent as compared with irrigated varieties in Texas averaging 52.9 percent.

TABLE 6.--Variation in oil content of castorbeans, grown on dry or irrigated land, by variety and crop year for 3 States and United States, 1951-53 crops[1]

Variety and crop year	Arkansas			Oklahoma			Texas			United States		
	Number of samples	Average	Relative variation[2]	Number of samples	Average	Relative variation[2]	Number of samples	Average	Relative variation[2]	Number of samples	Average	Relative variation[2]
Dryland:												
Conner		*Percent*	*Percent*		*Percent*	*Percent*		*Percent*	*Percent*		*Percent*	*Percent*
1951	--	--	--	48	54.20	3.8	77	54.81	3.1	125	54.58	3.2
1952	--	--	--	45	54.40	3.4	220	53.57	3.9	265	53.71	3.9
1953	--	--	--	41	53.64	3.5	241	53.38	3.4	282	53.42	3.3
Cimarron												
1952	64	55.67	2.9	29	54.53	3.1	31	54.78	3.0	124	55.18	3.1
1953	23	55.50	2.5	28	55.00	3.8	56	54.52	3.1	107	54.86	3.0
USDA 74												
1951	--	--	--	29	54.17	3.5	--	--	--	29	54.17	3.5
1952	--	--	--	88	54.35	3.0				88	54.35	3.0
1953	--	--	--	44	52.16	3.3	51	51.93	4.1	95	52.04	3.6
All varieties												
1951	--	--	--	77	54.19	3.6	77	54.81	3.1	154	54.50	3.4
1952	64	55.67	2.9	162	54.39	3.5	251	53.72	4.0	477	54.21	3.8
1953	23	55.50	2.5	113	53.40	4.1	348	53.35	3.8	484	53.46	3.8
Three year average	87	55.62	2.6	352	54.03	3.7	676	53.65	4.0	1,115	53.93	3.8
Irrigated:												
Baker 1												
1952							156	51.78	3.7	156	51.78	3.7
1953							19	50.67	4.6	19	50.67	3.7
Baker 195												
1952							16	52.03	1.6	16	52.03	1.6
Cimarron												
1952							34	56.56	2.8	34	56.56	2.8
1953							49	54.06	3.4	49	54.06	3.4
All varieties												
1952							206	52.59	4.7	206	52.59	4.7
1953							68	53.11	4.6	68	53.11	4.6
2-year average							274	52.72	4.8	274	52.72	4.8
Dryland and Irrigated--all varieties:												
1951				77	54.19	3.6	77	54.81	3.1	154	54.50	3.4
1952	64	55.67	2.9	162	54.39	3.5	457	53.21	4.5	683	53.72	4.3
1953	23	55.50	2.5	113	53.40	4.1	416	53.31	3.9	552	53.42	3.9
Three year average	87	55.62	2.6	352	54.03	3.7	950	53.38	4.2	1,389	53.69	4.1

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[1] Oil content on clean, moisture-free basis as determined at laboratory. In some instances the averages do not exactly agree with those shown elsewhere because all samples were not included here.

[2] Coefficient of variation.

TABLE 7.—Characteristics of castorbeans as shown by field and laboratory analyses, by State and variety, 1951 crop

State and variety	Sample (number)	Field analysis				Laboratory analysis			
		Foreign material	Moisture	Unhulled beans	Cracked and broken beans	Moisture	Oil (clean-moisture free basis)	Nitrogen (moisture and oil free)	Foreign material
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Oklahoma:									
Cimarron	2	0.6	5.0	7.0	2.2	6.0	53.5	7.6	1.7
Conner	48	1.2	5.8	10.7	5.2	5.8	54.2	6.6	1.9
U. S. 74	29	.7	5.6	4.2	4.2	5.6	54.2	6.5	1.0
All varieties	79	1.0	5.7	8.2	4.8	5.7	54.2	6.5	1.7
Texas:									
Baker 7	5	1.0	4.4	1.8	7.3	5.0	52.1	6.7	1.5
Cimarron	12	1.4	5.2	6.7	6.7	5.6	54.6	6.4	3.0
Conner	77	1.0	5.5	6.8	5.4	5.5	54.8	6.6	1.8
U. S. 74	2	.2	5.2	3.3	1.8	5.4	54.4	7.4	1.1
All varieties	96	1.0	5.5	6.6	5.5	5.5	54.6	6.6	2.0
United States:									
Baker 7	5	1.0	4.4	1.8	7.3	5.0	52.1	6.7	1.5
Cimarron	14	1.1	5.2	6.7	6.1	5.6	54.5	6.5	2.6
Conner	125	1.1	5.6	8.3	5.3	5.6	54.5	6.6	1.9
U. S. 74	31	.7	5.6	4.1	4.1	5.5	54.2	6.5	1.0
All varieties	175	1.0	5.6	7.4	5.2	5.6	54.4	6.6	1.8

The coefficient of variation in oil content was approximately the same in 1953 as the earlier year in both dryland and irrigated areas.

In the 1954-55 season, Oklahoma dryland varieties averaged 55.0 percent oil as compared with a low of 53.7 percent in Arkansas and 53.9 percent in Texas. In the irrigated areas, average oil content in New Mexico was 53.1 percent, in Texas, 52.5 percent (table 10).

Oil content of castorbeans of a given variety varies appreciably between hulling centers. This point is illustrated by table 11.

Conner and Baker 1 varieties showed the greatest differences in oil content between hulling centers and Cimarron and U. S. 74 the smallest. The high oil-content hulling center for Conner and Baker 1 was located in the Texas Panhandle whereas the low oil-content hulling center was located in south or south central Texas.

Oil content of the Conner variety in Texas, by hulling centers, showed a general tendency to decrease from north to south. This was especially noticeable in 1952. In 1953, the high oil-content centers for the most part were in the north and the low oil-content centers in the south. The intermediate oil-content centers, however, did not show a clear pattern but varied between these extremes.

Relationship of Oil Content to Cracked and Broken Beans

Cracked and broken beans and oil content showed appreciable positive correlation in 40 percent of the cases studied. Each case represented one variety at a single hulling center. Scatter diagrams for 29 of the 71 cases showed some consistency of relationship. Relationship in the remaining 42 cases appeared to be essentially zero. In most of the 29, taken singly, the number of observations was too small to be considered statistically significant. Taken together, however, there was appreciable consistency.

Among varieties, the Conner showed the highest degree of relationship between cracked and broken beans and oil content. The coefficients of correlation ranged from 0.16 at Atlanta, Tex., to 0.80 at Jourdanton, Tex. The median coefficient of correlation was 0.53. A 1-percent change in cracked and broken beans was associated with 0.5 percent median change in oil content. In one case as much as 63 percent of the variation in oil content was explained by cracked and broken beans, when measured by the coefficient of determination.

Three other leading varieties, Cimarron, U. S. 74, and Baker 1, showed about the same results.

With the quantity of cracked and broken castorbeans in an average lot representing only from 3 to 5 percent of the gross weight, it is often difficult to measure statistically the influence that they have on oil content of a farmer's lot. Nevertheless, as developed in the storage section of this report, cracked and broken beans appear to contain significantly more oil than whole sound beans.

TABLE 8.—Characteristics of castorbeans grown on dryland or under irrigation, as determined by field and laboratory analyses, by State and variety, 1952 crop

State and variety	Samples		Field analysis				Laboratory analysis			
									Oil	
	No.	Pounds	Moisture	Free foreign material	Unhulled beans	Cracked & broken beans	Foreign material	Moisture (clean sample)	Clean moisture free	Whole sample
Arkansas:										
Dryland			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Cimarron	64	3,371	5.43	.2	7.5	2.5	1.70	6.1	55.7	51.4
Arizona:										
Irrigated										
Baker 1	3	10,667	4.83	2.1	5.5	9.6	2.86	5.4	50.0	46.0
Hybrid	3	12,851	5.47	2.1	3.2	9.5	2.48	5.6	49.4	45.5
All varieties	6	11,759	5.15	2.1	4.3	9.6	2.67	5.5	49.7	45.7
California:										
Irrigated										
Baker 1	2	44,830	6.05	2.4	7.5	3.9	2.65	6.5	51.4	46.8
Baker 195	4	30,313	6.40	3.8	6.3	4.9	3.46	6.9	50.4	45.3
All varieties	6	35,152	6.28	3.3	6.7	4.6	3.19	6.7	50.7	45.8
Oklahoma:										
Dryland										
Baker 1	1	2,073	4.70	2.0	5.8	4.4	1.20	4.7	51.1	48.1
Cimarron	29	1,209	5.13	.9	3.6	4.3	1.53	5.2	54.5	50.8
Conner	45	715	5.32	.5	5.9	6.0	2.00	5.4	54.4	50.4
U.S. 74	88	1,396	5.68	.7	4.8	3.5	1.54	5.7	54.3	50.5
All dryland	163	1,178	5.47	.7	4.9	4.3	1.66	5.5	54.4	50.5
Irrigated										
Cimarron	10	2,471	4.56	.7	4.4	5.3	1.61	5.1	55.3	51.6
All varieties	173	1,252	5.42	.7	4.9	4.4	1.66	5.5	54.4	50.5
Texas:										
Dryland										
Baker 1	2	1,538	4.25	1.2	2.9	2.3	1.38	4.5	51.5	48.5
Cimarron	31	1,107	5.06	.4	3.4	4.3	1.18	5.4	54.8	51.2
Conner	220	760	5.56	.4	4.7	5.0	1.52	5.8	53.6	49.7
U.S. 74	15	1,145	5.26	1.2	4.2	4.2	1.94	5.7	52.8	48.9
All dryland	268	827	5.47	.5	4.5	4.9	1.51	5.7	53.6	49.8
Irrigated										
Baker 1	156	4,439	4.91	1.2	3.7	3.0	1.70	5.3	51.8	48.2
Baker 7	9	10,078	5.23	3.6	5.2	5.0	4.55	5.6	54.0	48.5
Baker 195	16	8,233	4.73	1.0	3.4	2.1	1.47	5.1	52.0	48.5
Cimarron	35	6,902	5.05	1.6	4.6	4.4	2.71	5.2	56.5	52.1
All irrigated	216	5,354	4.93	1.3	3.8	3.2	1.97	5.3	52.7	48.9
All varieties	484	2,848	5.23	.9	4.2	4.1	1.71	5.5	53.2	49.4
United States:										
Dryland										
Baker 1	3	1,716	4.40	1.5	3.8	3.0	1.32	4.5	51.4	48.4
Cimarron	124	2,299	5.27	.4	5.6	3.4	1.53	5.7	55.2	51.2
Conner	265	752	5.52	.4	4.9	5.2	1.60	5.7	53.7	49.8
U.S. 74	103	1,359	5.62	.8	4.7	3.6	1.59	5.7	54.1	50.2
All dryland	495	1,272	5.47	.5	5.0	4.4	1.58	5.7	54.1	50.3
Irrigated										
Baker 1	161	5,057	4.92	1.2	3.7	3.1	1.73	5.4	51.7	48.1
Baker 7	9	10,078	5.23	3.6	5.2	5.0	4.55	5.6	54.0	48.5
Baker 195	20	12,649	5.07	1.6	4.0	2.7	1.87	5.5	51.7	47.9
Cimarron	45	5,917	4.94	1.4	4.5	4.6	2.46	5.2	56.2	52.0
Hybrid	3	12,851	5.47	2.1	3.2	9.5	2.48	5.6	49.4	45.5
All irrigated	238	6,146	4.96	1.4	4.0	3.5	2.00	5.4	52.6	48.8
All varieties	733	2,854	5.30	.8	4.7	4.1	1.72	5.6	53.7	49.8

Relationship of Oil Content to Unhulled Beans

Unhulled castorbeans and oil content appear to be inversely related. The hulls contain essentially no oil. They may even absorb oil during the extraction process. In 1952-53 the U. S. 74 variety at the Hugo, Okla., center showed the highest correlation coefficient (-0.70) for the relationship of unhulled beans and oil content. The Baker 1 variety showed lower correlation indexes but displayed a more consistent relationship among the hulling centers. At Lehman, Tex., the coefficient of correlation was -0.36 as compared with -0.31 at Friona, Tex. The Conner variety at Whitesboro, Tex., revealed a -0.14 coefficient of correlation.

The importance of these analyses rests with the economic interpretation from the farmer's and processor's viewpoints. From the processor's viewpoint, hulls reduce the

TABLE 9.--Characteristics of castorbeans grown on dryland or under irrigation, as determined by field and laboratory analyses, by State and variety, 1953 crop

State and variety	Samples		Field analysis				Laboratory analysis			
									Oil	
	No.	Pounds	Moisture	Free foreign material	Unhulled beans	Cracked and broken beans	Foreign material	Moisture (clean sample)	Clean moisture free	Whole sample
Arkansas:										
Dryland			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Cimarron	23	1,609	5.70	0.4	5.1	4.8	1.41	5.7	55.5	51.6
Oklahoma:										
Dryland										
Cimarron	28	1,640	5.66	.3	3.5	4.7	.88	6.1	55.0	51.2
Conner	41	1,000	5.58	.4	4.4	6.3	1.41	5.9	53.6	49.7
U. S. 74	45	1,128	5.55	.3	4.9	3.7	1.17	6.9	52.2	48.0
All varieties	114	1,208	5.59	.3	4.4	4.9	1.19	6.4	52.9	48.7
Texas:										
Dryland										
Baker 1	3	3,913	4.46	.4	4.9	3.0	1.33	5.3	50.1	46.8
Baker 195	1	548	5.95	.2	5.9	5.7	1.26	6.0	49.0	45.5
Cimarron	56	1,526	5.62	.2	4.0	4.3	1.06	6.0	54.7	50.7
Conner	241	1,114	5.68	.4	3.9	5.4	1.33	6.1	53.4	49.5
Hybrid 4	7	938	5.75	.2	2.2	3.2	.64	5.9	50.1	46.8
Mixed	4	1,324	6.54	.4	2.3	5.3	.90	7.5	53.0	48.6
U. S. 174	51	980	5.56	.2	5.0	2.9	1.10	6.0	51.9	48.3
All dryland	363	1,179	5.66	.3	4.0	4.8	1.24	6.0	53.3	49.4
Irrigated										
Baker 1	19	12,195	5.49	.7	6.5	2.8	1.90	5.9	50.6	46.8
Baker 195	1	2,300	5.04	1.3	2.1	2.3	1.40	5.5	49.5	46.1
Cimarron-Hybrid 4	49	9,328	4.90	.9	5.2	4.5	1.88	5.3	54.1	50.2
Hybrid 4	6	3,805	5.45	.9	5.6	5.0	1.89	5.5	50.0	46.4
Mixed	3	40,610	5.04	1.5	4.7	5.1	1.92	5.3	56.2	49.1
All irrigated	78	10,714	5.09	.9	5.5	4.1	1.88	5.5	52.9	49.0
All varieties	441	2,865	5.56	.4	4.3	4.7	1.35	5.9	53.2	49.3
New Mexico:										
Irrigated										
Cimarron	4	3,415	5.52	1.0	9.1	6.8	2.96	5.2	55.8	51.3
Hybrid 4	2	2,358	5.34	.8	5.8	7.0	2.02	4.9	54.8	51.1
U. S. 74	1	6,362	5.30	.3	6.1	5.1	1.38	4.8	56.3	52.8
All varieties	7	3,534	5.43	.9	7.7	6.6	2.47	5.1	55.6	51.5
United States										
Dryland										
Baker 1	3	3,913	4.46	.4	4.9	3.0	1.33	5.3	50.1	46.8
Baker 195	1	548	5.95	.2	5.9	5.7	1.26	6.0	49.0	45.4
Cimarron	107	1,574	5.65	.3	4.1	4.5	1.09	6.0	55.0	51.0
Conner	282	1,098	5.67	.4	3.9	5.5	1.34	6.0	53.4	49.5
Hybrid 4	7	938	5.75	.2	2.2	3.2	.64	5.9	50.1	46.8
Mixed	4	1,324	6.54	.4	2.3	5.3	.90	7.5	53.0	48.6
U. S. 74	96	1,050	5.55	.2	5.0	3.3	1.13	6.4	51.5	47.5
All dryland	500	1,206	5.64	.3	4.1	4.8	1.24	6.1	53.3	49.4
Irrigated										
Baker 1	19	12,195	5.49	.7	6.5	2.8	1.90	5.9	50.7	46.8
Baker 195	1	2,300	5.04	1.3	2.1	2.3	1.40	5.5	49.5	46.1
Cimarron	53	8,881	4.95	.9	5.5	4.7	1.96	5.3	54.2	50.3
Hybrid 4	8	3,444	5.36	.9	5.7	5.5	1.92	5.3	51.2	47.6
Mixed	3	40,610	5.04	1.5	4.7	5.1	1.92	5.3	56.2	49.1
U. S. 74	1	6,362	5.30	.3	6.1	5.5	1.38	4.8	56.3	52.8
All irrigated	85	10,123	5.12	.9	5.7	4.3	1.93	5.4	53.2	49.2
All varieties	585	2,501	5.57	.4	4.4	4.8	1.34	6.0	53.3	49.3

oil outturn whereas, from the farmer's viewpoint, hulls are foreign material and increase his transportation costs. As indicated earlier, unhulled beans tend to increase with moisture content of the beans. Insofar as the farmer can lower the moisture content of his beans, he can contribute to the marketing efficiency of his commodity.

EXPERIMENTS ON STORAGE OF CASTORBEANS

Farm storage of castorbeans has not been practiced to any appreciable extent. Farmers do occasionally store them in the hulls for drying purposes. Processors usually have to store the hulled beans for a short season because they receive the bulk of the crop within the relatively short harvesting period, whereas they process beans the year around.

Public information on the storage characteristics of castorbeans has been practically nonexistent. The study reported here revealed changes in physical and chemical charac-

TABLE 10.—Characteristics of castorbeans grown on dryland or under irrigation, as determined by field and laboratory analyses, by State and variety, 1954 crop

State and variety	Samples		Field analysis				Laboratory analysis			
									Oil	
	No.	Pounds	Moisture	Free foreign material	Unhulled beans	Cracked & broken beans	Foreign material	Moisture (clean sample)	Clean moisture free	Whole sample
Arkansas:										
Dryland			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Cimarron	8	1,798	5.71	0.3	6.8	5.0	1.66	6.2	53.7	49.6
Missouri:										
Dryland										
Cimarron	4	949	8.06	.1	8.7	6.4	1.68	6.5	54.2	50.0
Oklahoma:										
Dryland										
Cimarron	20	1,428	5.30	.9	3.7	4.5	2.06	5.0	54.7	50.9
Conner	12	940	5.17	.5	3.3	8.6	1.39	5.2	55.5	52.0
All varieties	32	1,255	5.25	.8	3.5	6.0	1.81	5.1	55.0	51.3
Texas:										
Dryland										
Baker	7	17,303	3.36	.9	8.0	3.4	2.46	4.5	52.1	48.5
Cimarron	27	1,989	4.96	.8	4.0	5.7	1.89	4.8	54.0	50.4
Conner	51	817	5.12	.3	4.8	6.5	1.61	6.2	54.1	50.0
Cimarron-Hybrid	6	7,340	3.35	1.6	4.1	4.5	2.03	4.0	53.0	49.9
All dryland	91	2,886	4.82	.6	4.8	5.9	1.79	5.5	53.9	50.0
Irrigated										
Baker	4	11,260	3.66	.9	8.8	3.3	2.72	4.9	52.0	48.2
Cimarron	1	—	5.20	1.0	2.8	4.3	1.56	5.0	55.5	51.9
Cimarron-Hybrid	2	9,040	4.70	.8	6.0	4.8	1.86	4.8	52.0	48.6
All irrigated	7	10,520	4.18	.9	7.2	3.8	2.31	4.9	52.5	48.8
All varieties	98	3,363	4.78	.6	5.0	5.8	1.82	5.5	53.8	49.9
New Mexico:										
Irrigated										
Cimarron	10	3,520	4.89	1.0	6.7	6.3	2.44	4.8	54.7	50.8
Hybrid 4	11	9,886	4.78	.8	2.6	5.0	1.25	5.0	51.7	48.5
Hybrid 7	20	7,181	4.86	1.5	4.5	6.0	2.51	5.1	53.1	49.1
All varieties	41	7,014	4.85	1.2	4.5	5.8	2.15	5.0	53.1	49.3
United States:										
Dryland										
Baker	7	17,303	3.36	.9	8.0	3.4	2.46	4.5	52.1	48.5
Cimarron	59	1,703	5.38	.7	4.6	5.2	1.90	5.2	54.2	50.4
Conner	63	840	5.13	.3	4.5	6.9	1.56	6.0	54.4	50.3
Cimarron-Hybrid	6	7,340	3.35	1.6	4.1	4.5	2.03	4.0	53.0	49.9
All dryland	135	2,382	5.07	.6	4.7	5.9	1.78	5.5	54.1	50.3
Irrigated										
Baker	4	11,260	3.66	.9	8.8	3.3	2.72	4.9	52.0	48.2
Cimarron	11	3,520	4.92	1.0	6.4	6.2	2.36	4.8	54.8	50.9
Cimarron-Hybrid	2	9,040	4.70	.8	6.0	4.8	1.86	4.8	52.0	48.6
Hybrid 4	11	9,886	4.78	.8	2.6	5.0	1.25	5.0	51.7	48.5
Hybrid 7	20	7,181	4.86	1.5	4.5	6.0	2.51	5.1	53.1	49.1
All irrigated	48	7,461	4.75	1.1	4.9	5.5	2.18	5.0	53.0	49.3
All varieties	183	3,708	4.99	0.7	4.8	5.8	1.88	5.4	53.8	50.0

TABLE 11.—Difference between hulling centers in castorbeans of lowest oil content and of highest oil content, by variety, 1952-53 season[1]

Variety	Lowest center		Highest center		Difference[2]
		Percent		*Percent*	*Percent*
Conner	San Antonio, Tex.	50.7	Wellington, Tex.	56.6	5.9
Baker 1	San Benito, Tex.	48.5	Friona, Tex.	54.0	5.5
Cimarron	Altus, Okla.	52.8	Hereford, Tex.	56.6	3.8
U. S. 74	Chillicothe, Tex.	52.5	Anadarko, Okla.	55.5	3.0

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[1] Oil content on a clean, moisture-free basis.
[2] The range, a crude measure of dispersion as determined from the array, represents the difference between the two extreme values.

teristics in beans in storage that should be taken into account for more efficient marketing.

The storage investigations were designed to answer two central questions: (1) How long may castorbeans be stored and maintain their quality? (2) What are the differences in characteristics and relationships of whole sound castorbeans and cracked and broken beans from storage with respect to the quantity and quality of extracted oil?

In October 1952, an experimental lot of 90,000 pounds of Conner variety castorbeans was set aside for research purposes at Whitesboro, Tex. The beans had been grown in the surrounding dryland areas, hulled at the Whitesboro receiving center, and stored in bulk in a quonset building.

The plan was to sample the beans in storage at regular intervals for at least 2 years. Three types of samples--(1) 100-percent whole beans, (2) 100-percent cracked and broken beans, and (3) representative mixtures of whole and of cracked and broken beans--were drawn twice a month whenever the outside temperature was above 80 degrees; at other times they were drawn only once a month. A total of 32 samples for each type was drawn during the 2 years' storage. The reason for the three series of samples was twofold: (1) to determine the relationship between whole beans and cracked and broken beans, and consequently (2) the degree to which whole beans and cracked and broken beans differed from representative samples containing both. The samples were analyzed for moisture and oil content and the laboratory-extracted oil was chemically analyzed for specific gravity, color, neutralization number, free fatty acids (as oleic), iodine number, and unsaponifiable matter. The first samples were drawn in February 1953.

This section of the report is based on the data developed during the time the castorbeans were in storage--October 1952 to October 1954.

Oil Content Through 2 Years' Storage

During the 24 months in storage, the average oil content (clean, moisture-free basis) of whole beans was 54.0 percent, as compared with 59.0 percent for cracked and broken beans. This represents 9.3 percent more oil in cracked and broken beans than in whole sound beans.[7]

Analysis of the castorbeans showed oil content at about the same level throughout the 2-year storage period (fig. 1). There was no discernible trend; apparently the variation in oil content during this period was due primarily to experimental error. Oil content of whole sound beans varied from 52.2 percent to 56.7; cracked and broken beans from 57.3 percent to 62.0 percent. The average (mean) deviation was 0.67 percent and 0.69 percent, respectively.[8]

Chemical Analysis of Oil from Beans in Storage

Chemical analyses of the oil from castorbeans stored up to 2 years were made to see whether it met the requirements of the National Stockpile Purchase Specifications for castor oil.[9] Castor oil for addition to the strategic stockpile was required to be well refined and free from suspended matter, sediment, and admixture of other oils, and to contain no oxidation inhibitors. It could be recovered either by a pressing operation or solvent extraction. In commercial grades No. 1 oil is recovered by a pressing operation and No. 3 by a solvent. No. 1 crude castor oil, after refinement, is brilliant, clear, and

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[7] On the "whole sample as received" basis, cracked and broken beans averaged 9.8 percent more oil than whole sound beans.

[8] Average deviation, a measure of dispersion, represents the sum of the absolute deviations of the items from the average, divided by the number of cases.

[9] National Stockpile Specifications (September 23, 1952) outlined the following chemical and physical requirements for Grades 1 and 3 castor oil, the test methods being those of the American Oil Chemists Society (A.O.C.S.) or the American Society for Testing Materials (A.S.T.M.) in effect at the time the contract was awarded:

Properties	Grade No. 1	Grade No. 3	A.O.C.S.	A.S.T.M.
Solubility at 20° C. (68° F.)	Complete	Complete	--------------	D960
Viscosity S.U.S.				
At 130° F. (54.4° C.)	500 to 550	450 to 550	--------------	D88
At 210° F. (98.9° C.) min.	95	90	--------------	D88
Acetyl value	140 to 150	140 to 150	Cd 4-40	-------------
Moisture and volatile				
At 212° F. (100° C.) max.	0.3	0.3	Ca 2c-25	-------------
Neutralization number or acid value, max.	3.0	12.0	--------------	D555
Color, Gardner 1933, max.	3	8	--------------	D555
Specific gravity, 60°/60° F.	.959 to .965	.957 to .965	Cc 10a-25	-------------
Saponification number	176 to 184	176 to 184	Cd 3-25	-------------
Unsaponifiable, maximum percent	0.7	0.8	Ca 6a-40	-------------
Iodine number (Wijs)	82 to 88	80 to 88	Cd 1-25	-------------
Appearance	Clear	Clear	--------------	D555

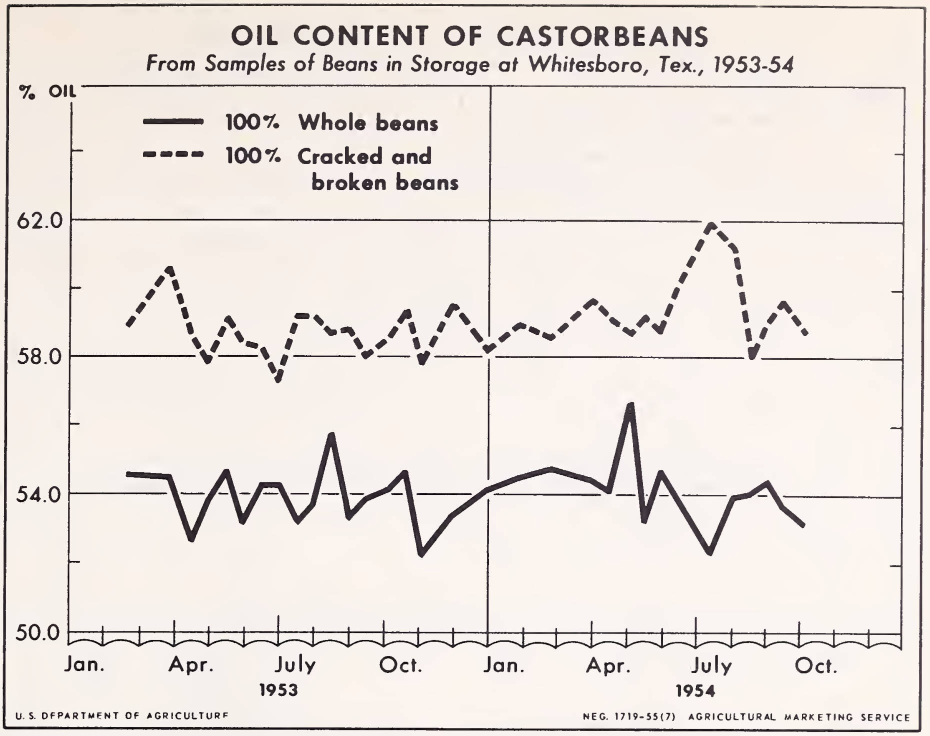

Figure 1.

nearly colorless, whereas No. 3 is somewhat more colored and contains impurities due to solvent action on the pomace.

Stockpile specifications require that grade No. 1 oil have a specific gravity within the limits of 0.959 and 0.965, and No. 3 within 0.957 and 0.965.

The specific gravity of the oil from 100-percent whole beans and from 100-percent cracked and broken beans each averaged 0.962 during the storage period. That from whole beans varied from 0.959 to 0.965, from cracked and broken beans, 0.956 to 0.964.

Oil from all 32 samples of whole beans met stockpile specifications regarding specific gravity for No. 1 oil, whereas 2 of the 32 samples from cracked and broken beans did not (fig. 2). The average deviation for the two types of samples was 0.001, which may be considered within the limits of tolerance for experimental error.

Color (Gardner number). The color of castor oil is important. In the crude oil color may affect subsequent processing and the end use of the product. Color varies with the variety of seed, environment during growth and nutrition, and method of processing. As determined by the Gardner 1933 standards, the maximum color number for No. 1 oil is 3, and for No. 3 oil, 8. The color is determined by comparison with standards of definite color composition. The lower the Gardner number, the lighter and clearer the oil. As the determination of color is a subjective test, some variation must be allowed for experimental error.

Castor oil extracted from the whole beans, as well as that from cracked and broken beans, met stockpile color specifications for No. 1 oil throughout the first year of storage--varying between Gardner 2 and 3 (fig. 3). In the second year, the oil tended to become darker, particularly in the last 3 months. A definitely darker color appeared in the oil from cracked and broken beans. About 75 percent of all samples in the second year met specifications for No. 1 oil. The average Gardner color during the 2-year storage experiment was 3--maximum for No. 1 oil--for both whole beans and cracked and broken beans. The variation in color of the castor oil appears to be insignificant.

Free fatty acid (as oleic) to meet National Stockpile Specifications must not exceed 1.5 percent for No. 1 crude castor oil and 6.0 percent for No. 3 oil. The free fatty acid requirements are stated in the National Stockpile Specifications as the "neutralization number," which equals 1.99 the free fatty acid value (as oleic).

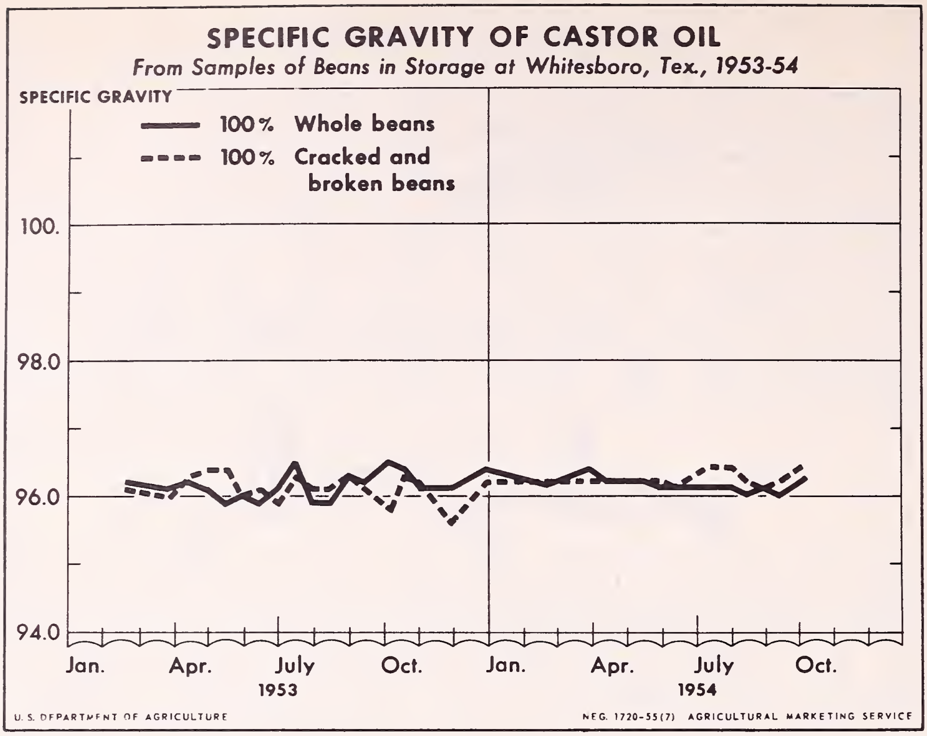

Figure 2.

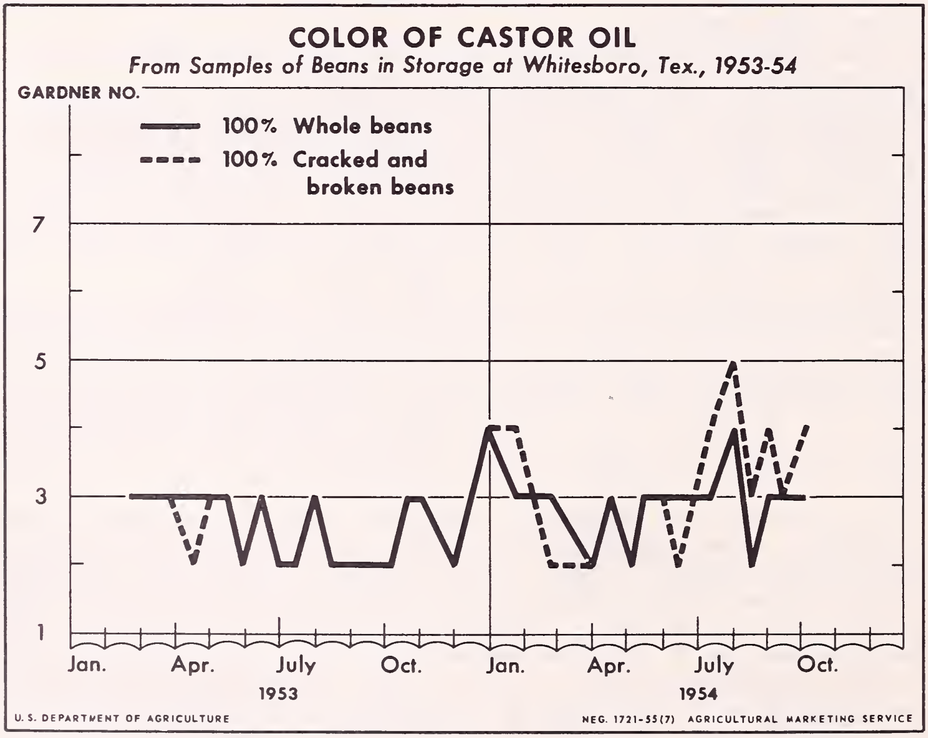

Figure 3.

During the 2-year storage period, the average free fatty acid (as oleic) content of the oil extracted from whole castorbeans was 0.34 percent, as compared with 0.57 percent in oil from cracked and broken beans. However, a comparison of the averages for the 2-year period gives a somewhat distorted picture as there appear to be distinct differences in the relationship for each of the 2 years (fig. 4).

For the first year in storage, free fatty acid content of the oil from both types of samples followed similar patterns of variation with no discernible trend. In 9 of the 14 samples during this first year, the free fatty acid of the oil from cracked and broken beans was higher than from whole beans, being 0.32 percent for oil from whole beans and 0.38 percent for that from cracked and broken beans. The range in variation was 0.47 percent and 0.40 percent, respectively. The neutralization number was 0.64 for whole beans and 0.76 for cracked and broken beans which, in either case, is well within the maximum of 3.0 for No. 1 castor oil as required by stockpile specifications.

During the second year of storage, the free fatty acid content of the oil from cracked and broken castorbeans was higher in 17 out of 18 samples than was that from whole beans. In the oil from whole beans, free fatty acid averaged 0.35 percent or approximately the same as the earlier year, with a range in variation of 0.28 percent. In the last 3 months of the second year of storage, however, the free fatty acid content appeared to be increasing. Free fatty acid content in oil from cracked and broken beans increased substantially during the second year of storage, averaging 0.72 compared with 0.38 the year before. The oil still met stockpile specifications, however, for No. 1 castor oil, as the range in variation of free fatty acid was 1.02 percent. After 7 months of the second storage year, a sharp, persistent increase took place in the free fatty acid content of oil from cracked and broken beans (fig. 4). In the last 5-month period, the increase was from 0.46 percent to 1.40 percent.

In summary, the first year of storage was characterized by the stability of free fatty acid content and an insignificant difference of free fatty acid content of the oil from whole beans and from cracked and broken beans. The second year of storage revealed a slight deterioration in the oil from cracked and broken beans with respect to free fatty acid. The acid value nearly doubled from the first year and approached the maximum allowed for No. 1 castor oil under National Stockpile Specifications. The average acid value for

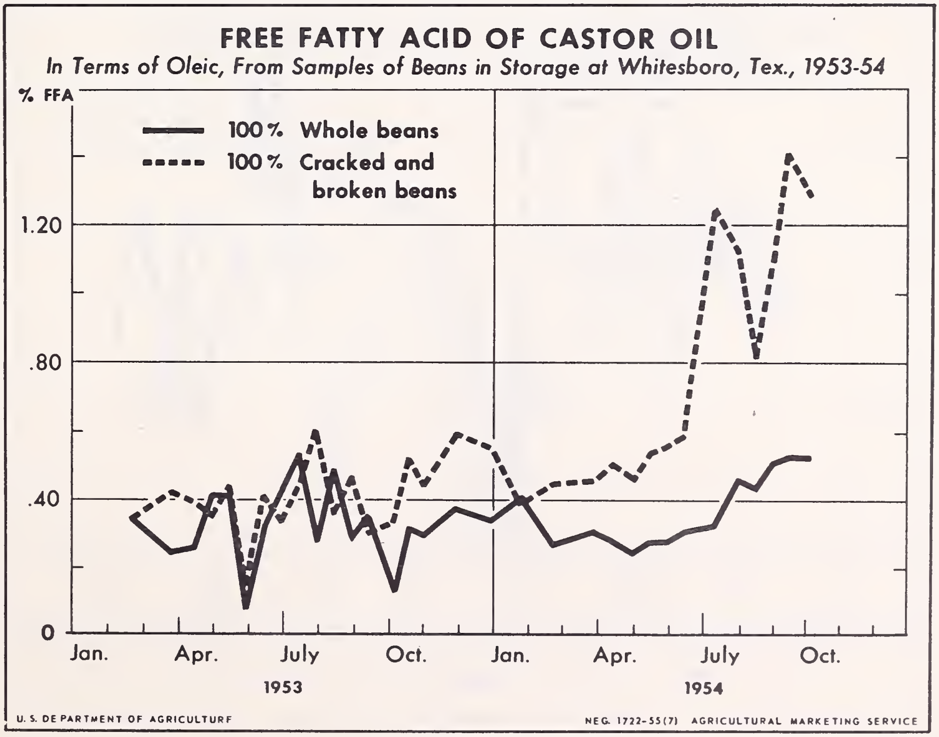

Figure 4.

the oil from whole beans remained at about its original level although there was a slight increase in the last quarter.

The fact that the free fatty acid content of the oil from cracked and broken beans increased in storage is not too alarming as most lots of castorbeans will average only from 3 to 5 percent of cracked and broken beans. When the oil from representative samples containing both whole beans and cracked and broken beans was analyzed, there was no significant difference between the average free fatty acid content of the oil in these samples (0.35 percent) and that of 100-percent whole beans (0.34 percent).

Excessive free fatty acid content of castor oil may result from (1) poor quality of the beans, (2) improper handling, or (3) inadequate control during the extraction process. Reduction of this free fatty acid in the refining process will increase the refining loss and the refining cost. Insofar as growers and marketing agents can improve their operations so as to reduce the acid value of castor oil, the costs of marketing this commodity should be reduced.

Iodine Number. The iodine number is a measure of the ''unsaturation'' of the castor oil and indicates the class to which it belongs. National Stockpile Specifications require that No. 1 castor oil have an iodine number, as determined by the Wijs method, between 82 and 88, and No. 3 oil between 80 and 88. Castor oil in its natural state has an iodine number below 100 and is considered nondrying. By chemical modification, however, the oil may be converted to a drying, or dehydrated, castor oil. The iodine number of dehydrated castor oil varies from 109 to 140.[10]

The iodine number of the oil from both whole beans and cracked and broken beans averaged 86 during the 2-year storage experiment (fig. 5). The values for both types of samples tended to show the same pattern of variation while remaining at approximately the same level throughout storage.

The iodine number of oil from whole beans varied from 83 to 89 or a range of 6 points as compared with the variation in cracked and broken beans from 82 to 89 or a range of 7 points.

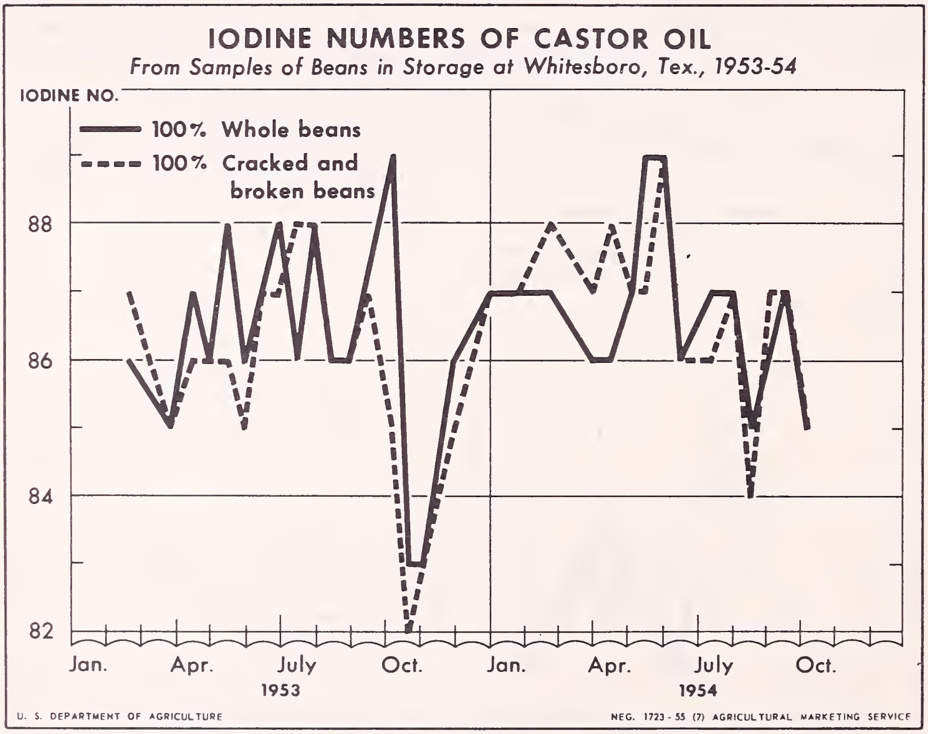

Figure 5.

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[10] "Vegetable Fats and Oils," by George S. Jamieson, Ed. 2, 1943, Reinhold Publishing Corp. p. 52.

Of the 32 samples analyzed during the 2 years the beans were in storage, the iodine number of the oil from cracked and broken beans was (1) exactly the same as the iodine number of oil from whole beans in 16 samples, (2) less than the iodine value of whole beans in 10 samples, and (3) more than the iodine value of whole beans in 6 samples.

From the foregoing analysis, it appears that castorbeans maintain quality in storage with respect to the iodine value of the oil. While the iodine number of the oil from cracked and broken beans was lower than that of the oil from whole beans in many instances, there was no significant difference between the averages during the storage period.

Unsaponifiable matter. National Stockpile Specifications place a maximum of 0.7 percent unsaponifiable matter for No. 1 castor oil and a maximum of 0.8 percent for No. 3 oil. The amount of unsaponifiable matter in the oil depends on the degree of refining.

During the storage period, the unsaponifiable matter tended to increase slightly for both whole beans and cracked and broken beans but remained within the maximum percentage for No. 1 castor oil. The changes in unsaponifiable matter occurred in what resembled cycles 5 or 6 months long (fig. 6). No correlation was apparent with seasonal or other climatic factors.

The pattern of variation for both types of samples was approximately the same. The average unsaponifiable matter for the oil from whole beans was 0.55 percent, varying from 0.21 percent to 0.78 percent, or a range of 0.57 percent. For the oil from cracked and broken beans it was slightly lower, 0.53 percent, varying from 0.31 percent to 0.74 percent, or a range of 0.43 percent.

Considering the 2-year storage experiment with respect to unsaponifiable matter, it appears (1) there was slight increase in unsaponifiable matter in the oil from both whole and cracked and broken castorbeans, (2) the increase in unsaponifiable matter tended to occur in cycles, and (3) the pattern of variation was the same in both cases.

Moisture Content of Beans in Storage

Excessive moisture is the most frequent cause of deterioration in castorbeans, and in beans in storage is apt to result in heating and molding. As moisture content in beans decreases, more dry matter, and consequently more oil, is included in a pound of beans.

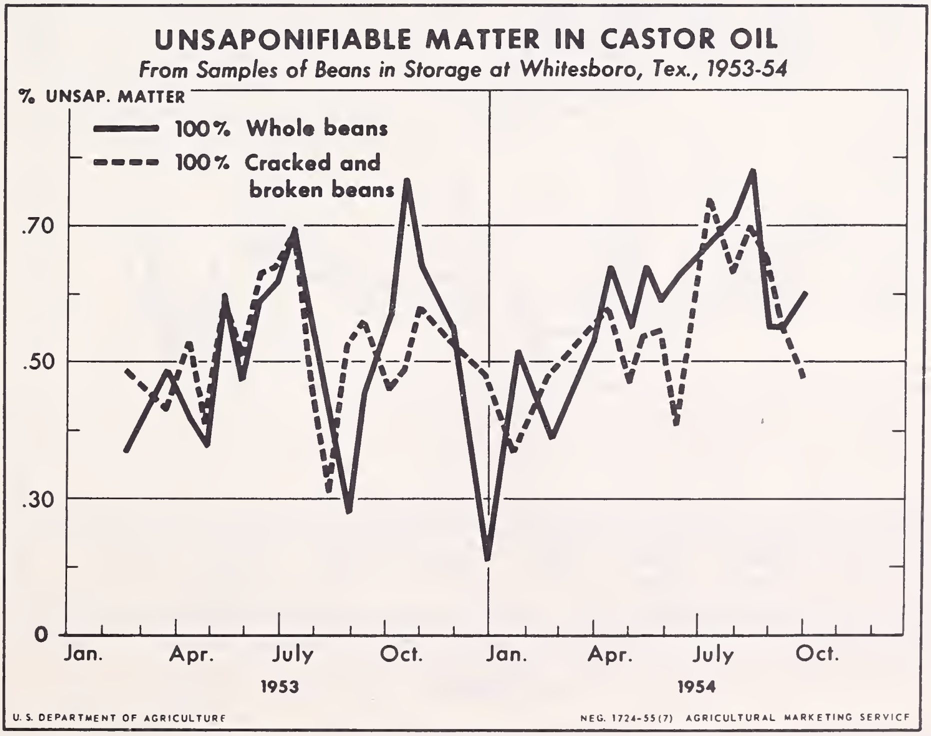

Figure 6.

Moisture content of the samples of whole beans at the time they were set aside for research purposes was 6.4 percent, and of the cracked and broken beans, 5.7 percent.

Castorbeans apparently absorb moisture in the cold months of storage and dry out considerably in the hot months (fig. 7), thus giving a seasonal variation in the moisture content. The variation in moisture content tended to follow the same pattern for both whole beans and cracked and broken beans during the 2-year storage period. However, cracked and broken beans contained less moisture. The average difference in moisture content over the storage period was 0.5 percent (excluding 2 erratic samples, one whole bean sample in August 1953 and one cracked and broken bean sample in June 1954). As cracked and broken beans are more oily, they are not likely to absorb as much moisture as whole beans.

In general, moisture content of the whole beans decreased from 6.4 percent in February 1953 to about 5 percent in mid-July and after a year in storage (October 1953) reached a low of 4.8 percent. In November 1953 the beans picked up moisture, increased to 5.5 percent and remained at this level through March 1954. The beans then increased in moisture content to the initial level (6.4 percent) in May 1954 and thereafter decreased to the lowest point (4.6 percent) in mid-July 1954.

A similar analysis was made of the moisture content of cracked and broken beans. The pattern of variation was the same except on a lower level.

In studies on the relationship of temperature to moisture content of castorbeans, as the temperature rose, moisture content decreased. The moisture content of whole beans, average weekly temperature, and monthly normal temperature during the storage period are shown in fig. 8.[11]

Moisture content of both whole sound beans and cracked and broken beans varied inversely in a linear relationship with average weekly temperature during the storage period. The coefficients of correlation were -0.55 and -0.51, respectively. Temperature explained about 30 percent of the variation in moisture content of whole sound beans and

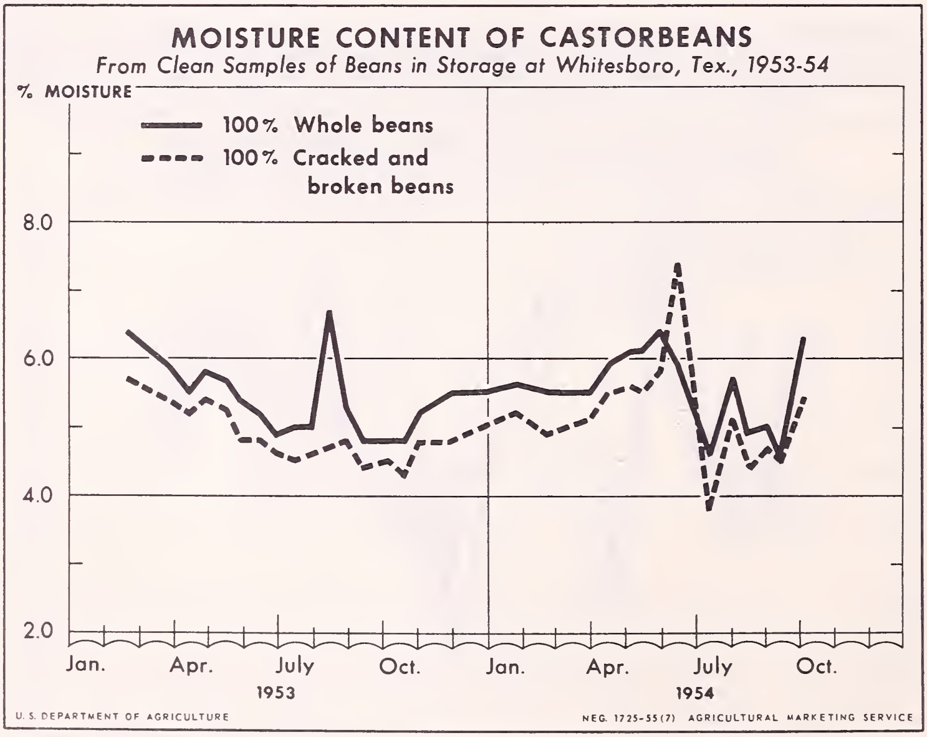

Figure 7.

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[11] As there is no weather station at Whitesboro, Tex., the climatological data from the Sherman station about 25 miles away were used.

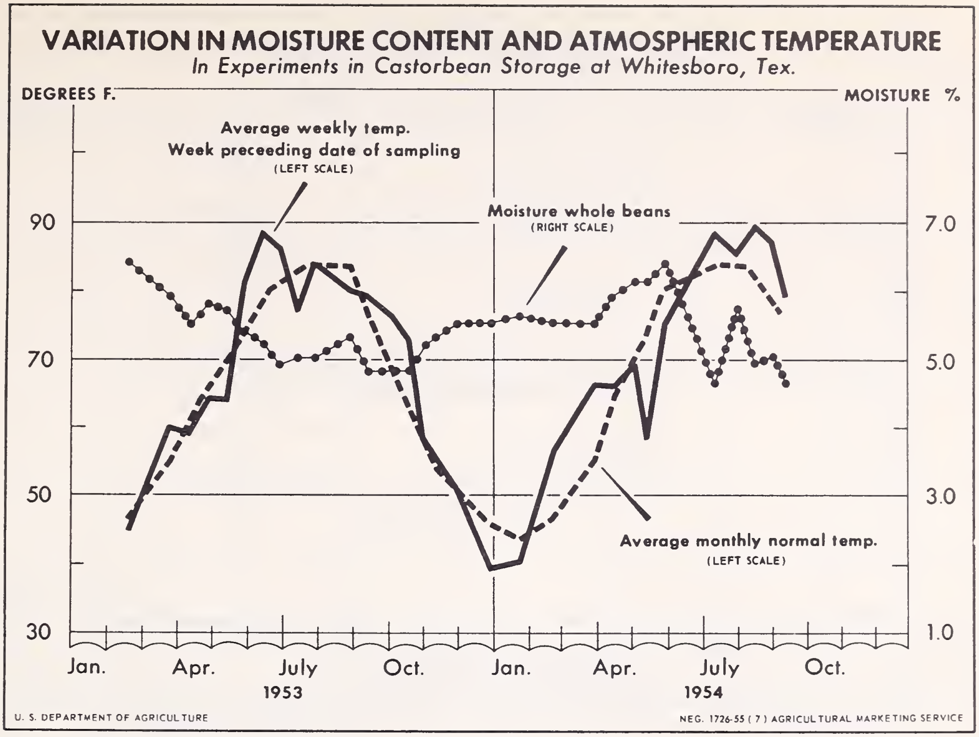

Figure 8.

26 percent of cracked and broken beans. On the average, with each degree increase in temperature, moisture content decreased about 0.019 percent for whole beans and about 0.017 percent for cracked and broken beans. The standard error of estimate was 0.42 percent in both instances (fig. 9).[12] It can be seen that within the range of the temperature during the storage period--39° to 89°--average moisture, as measured by the fitted straight line, decreased from 6 to 5 percent for whole castorbeans. The decrease in moisture for cracked and broken beans was slightly less.

Another factor affecting the moisture content of castorbeans in storage is precipitation. Monthly precipitation in the storage area (Whitesboro) is normally high in the spring, averaging about 5 inches, and low in the winter, averaging about 2 inches. Precipitation and moisture content of the beans showed a positive relationship. The coefficient of correlation was 0.39. This indicates that about 15 percent of the variation in the moisture content of whole castorbeans to be accounted for by the variation in rainfall. Precipitation thus appears to be about half as important in explaining the variation in moisture content as is temperature.

Relative humidity was also found to be positively correlated with the moisture content of castorbeans during the storage period. The coefficient of correlation was 0.45 which indicates that relative humidity explained 20 percent of the variation in moisture content.

Some interesting relationships are revealed when the combined effect of temperature, precipitation, and relative humidity on moisture is measured. The correlation coefficient between moisture content and temperature is reduced from -0.55 to -0.45 when the effect of precipitation and relative humidity is eliminated. Only 20 percent of the variation in moisture was explained by temperature. The correlation between temperature and precipitation was -0.18 and between temperature and relative humidity was -0.46.

The correlation coefficient between moisture and precipitation is similarly reduced from 0.39 to 0.29 when temperature and relative humidity are held constant, explaining 8 percent of the variation in moisture. When the effect of temperature and precipitation is eliminated, the coefficient of correlation between moisture and relative humidity is reduced from 0.45 to 0.15.

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[12] Standard error of estimate is a measure of the variation or scatter about the line of regression. In a normal distribution, one standard error includes about two-thirds of the cases when measured plus or minus about the line of regression.

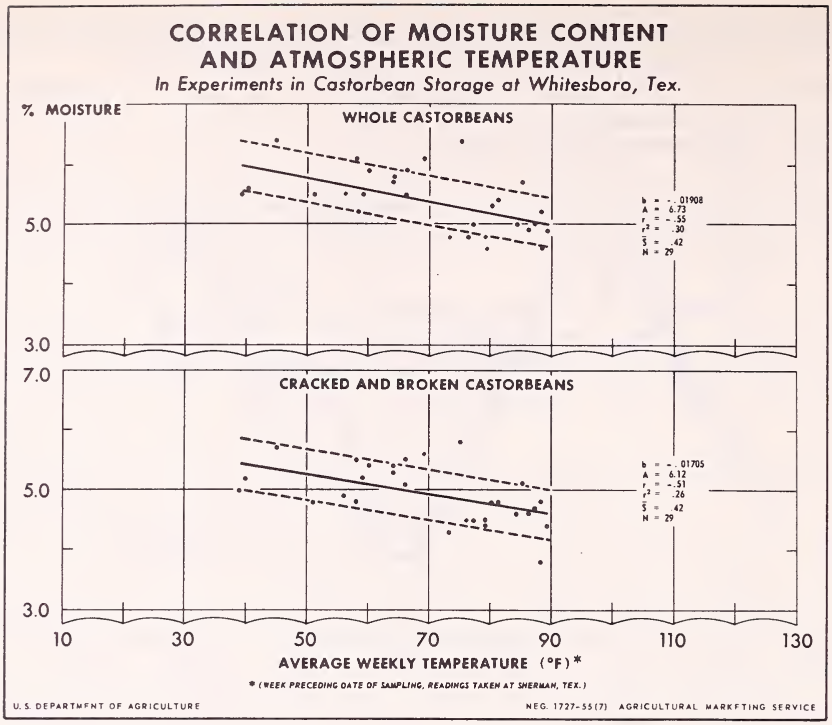

Figure 9.

The multiple correlation coefficient, measuring the relative importance of temperature, precipitation, and relative humidity combined in explaining the differences in moisture content, was 0.63. Judging from this about 40 percent of the variation in moisture was associated with variation in temperature, precipitation, and relative humidity. The standard error of estimate was 0.41. The results of the correlation analyses are summarized in table 12.

About 60 percent of the variation in moisture content failed to be accounted for by the analysis made of temperature, precipitation, and relative humidity.[13] To what extent the unexplained variation is due to a natural drying of the beans or other reasons cannot be ascertained from the data.

Of the interrelationships in this study, two points stand out.

(1) Castorbeans store well under normal conditions--they maintain their commercial grade in storage. This knowledge should be beneficial to growers and processors. Under favorable conditions a farmer might increase his returns by storing his beans rather than selling at harvest when the market facilities may be congested and prices relatively low. After 2 years in storage, the oil from both whole beans and cracked and broken beans met National Stockpile specifications for No. 1 castor oil. The oil from cracked and broken beans was slightly lower in quality than that from whole beans with respect to free fatty acid. However, the average farmer's lot contains only from 3 to 5 percent of cracked and broken beans, and when oil from samples of 100-percent whole beans was compared with that from beans containing approximately average proportions of cracked and broken ones, there was very little difference in free fatty acid content--it was 0.34 percent and 0.35 percent, respectively.

The application of these relationships, however, has certain limitations. First, there was no attempt to segregate cracked and broken beans in storage to determine their storage characteristics and keeping qualities. No reason is apparent from the analysis, however, why freshly hulled beans from the current crop, with no more than 6 percent of

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[13] Coefficient of nondetermination is the square of the coefficient of alienation as well as the complement of the coefficient of determination. It measures the percentage of variation unexplained in the dependent variable when associated with one or more independent variables.

TABLE 12.--Relationships between moisture content of castorbeans and temperature, precipitation, and relative humidity during storage at Whitesboro, Tex., 1953 and 1954

Variables			Coefficients of--		
Dependent	Independent	Held constant	Regression	Determination	Correlation
Moisture	Temperature	None	-0.019	0.301	-0.548
Do.	do.	Precipitation	- .017	.277	- .527
Do.	do.	Precipitation and relative humidity	- .015	.200	- .448
Moisture	Precipitation	None	.169	.155	.393
Do.	do.	Temperature	.130	.126	.356
Do.	do.	Temperature and relative humidity	.110	.083	.289
Moisture	Relative humidity	None	.035	.200	.447
Do.	do.	Precipitation	.027	.117	.342
Do.	do.	Temperature	.019	.069	.262
Do.	do.	Temperature and precipitation	.011	.023	.151
Moisture	Temperature, precipitation, and relative humidity	None	---	.403	.635
Temperature	Precipitation	None	-2.287	.034	- .184
Temperature	Relative humidity	None	-1.030	.211	- .460
Do.	do.	Precipitation	-1.033	.184	- .429
Precipitation	Relative humidity	None	.073	.164	.405
Do.	do.	Temperature	.073	.135	.367

moisture and 5 percent of cracked and broken, should deteriorate significantly in storage for at least 2 years.

Secondly, no investigations were made into the keeping quality of the castor oil. It is the opinion of some in the industry that oil from cracked and broken beans deteriorates or goes out of condition more quickly than does the oil from whole sound beans. The relative keeping qualities of each of these oils need further research. If the oil is further processed or used immediately after extraction, there is little reason to believe it would need special treatment or handling.

(2) Cracked and broken beans contain more oil per pound than whole beans. In the storage experiment at Whitesboro, samples of cracked and broken beans yielded 9.3 percent more oil than did samples of whole sound beans. Similar but more restricted tests, involving different areas and varieties, indicated that cracked and broken beans contained 11.5 percent more oil than whole beans.

APPENDIX

TABLE 13.--Characteristics of castorbeans as shown by field and laboratory analyses, by variety and hulling center, 1951 crop

Variety and hulling center	Samples	Field analysis				Laboratory analysis			
		Moisture	Free foreign material	Unhulled beans	Cracked and broken beans	Foreign material	Moisture, clean sample	Oil, clean moisture free basis	Nitrogen moisture and oil free
Conner:									
Oklahoma:	*Number*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Ardmore	13	5.4	0.9	8.9	6.2	1.8	5.7	54.6	6.6
Erick	12	5.6	1.9	4.4	4.0	.9	5.6	55.1	6.4
Henryetta	13	6.4	.7	16.8	5.8	1.3	6.2	53.4	6.7
Ripley	10	5.9	1.2	12.5	4.5	3.7	5.6	53.6	6.6
State	48	5.8	1.2	10.7	5.2	1.9	5.8	54.2	6.6
Texas:									
Brownwood	17	5.1	1.4	8.4	3.7	1.8	5.6	54.2	6.8
Chillicothe	9	5.8	1.8	8.4	8.0	2.1	5.4	56.0	6.3
Hereford	2	6.8	.5	5.2	3.3	([1])	6.8	55.4	6.7
Pecos	9	5.3	1.3	3.4	5.3	2.6	4.7	54.2	7.0
Stephenville	17	6.0	1.0	6.1	3.7	2.1	5.7	54.1	6.5
Vernon	12	5.0	.5	5.3	7.5	1.9	5.4	54.9	6.4
Wellington	11	5.9	.3	7.8	6.6	.6	5.6	56.1	6.8
State	77	5.5	1.0	6.8	5.4	1.8	5.5	54.8	6.6
United States	125	5.6	1.1	8.3	5.3	1.9	5.6	54.5	6.6
Baker 7:									
Texas:									
Hereford	5	4.4	1.0	1.8	7.3	1.5	5.0	52.1	6.7
Cimarron:									
Oklahoma:									
McAlester	2	5.0	0.6	7.0	2.2	1.7	6.0	53.5	7.6
Texas:									
Chillicothe	4	5.3	1.5	9.8	7.7	2.3	5.3	54.1	6.5
Vernon	8	5.1	1.0	5.1	6.2	3.7	5.7	54.9	6.3
State	12	5.2	1.4	6.7	6.7	3.0	5.6	54.6	6.4
United States	14	5.2	1.1	6.7	6.1	2.6	5.6	54.5	6.5
U. S. 74:									
Oklahoma:									
Altus	17	5.6	0.7	5.1	5.3	1.1	5.5	55.5	6.5
Holdenville	3	5.8	.4	1.4	2.4	([1])	6.1	53.3	6.6
McAlester	9	5.7	.9	3.4	2.6	.5	5.5	52.0	6.4
State	29	5.6	.7	4.2	4.2	1.0	5.6	54.2	6.5
Texas:									
Brownwood	2	5.2	.2	3.3	1.8	1.1	5.4	54.4	7.4
United States	31	5.6	.7	4.1	4.1	1.0	5.5	54.2	6.5

[1] Information not available.

TABLE 14.—Characteristics of castorbeans, dryland and irrigated, as shown by field and laboratory analyses, by variety and hulling center, 1952 crop

Variety and hulling center	Samples	Weight of lot	Field analysis				Laboratory analysis			
			Moisture	Free foreign material	Unhulled beans	Cracked & broken beans	Foreign material	Moisture, clean sample	Oil	
									Clean, moisture free basis	Whole sample
Conner:										
Dryland:										
Oklahoma:	*Number*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Altus	1	846	5.30	0.4	2.3	8.0	0.77	5.6	56.3	52.8
Anadarko	8	584	5.38	.2	3.2	6.2	1.04	5.4	54.9	51.4
Ardmore	7	668	5.16	.6	10.1	6.8	3.29	5.4	55.2	50.5
Erick	4	1,059	4.81	.3	3.7	3.7	1.17	5.2	55.1	51.6
Henryetta	9	571	5.39	.7	6.5	5.6	2.10	5.5	53.5	49.4
Ripley	7	616	5.37	.6	3.7	6.9	1.60	5.5	53.6	49.8
Rush Spring	9	813	5.50	.7	7.3	5.5	2.57	5.6	54.3	50.0
State	45	715	5.32	.5	5.9	6.0	2.00	5.4	54.4	50.4
Texas:										
Atlanta	11	547	6.02	.2	2.2	4.2	.69	6.2	53.7	50.0
Bonham	10	634	5.09	.2	3.5	4.7	1.16	4.9	53.3	50.1
Brownwood	6	308	5.17	.4	7.3	6.1	3.47	6.0	53.3	49.1
Carbon	7	603	5.20	.5	3.0	5.5	1.42	5.7	52.8	49.1
Chico	9	389	5.62	.2	3.5	3.5	1.13	5.4	52.9	49.4
Chillicothe	9	1,094	5.39	1.3	4.5	5.4	2.47	5.7	56.2	51.8
Clarksville	10	826	6.17	.1	3.6	3.2	.97	6.4	54.2	50.3
Cross Plains	3	368	5.57	.9	5.1	3.2	2.05	5.7	51.5	47.8
Devine	5	1,037	5.86	2.2	22.9	10.5	4.44	6.2	50.9	45.5
Elkhart	4	758	6.01	.3	8.6	4.9	2.43	6.3	54.6	49.9
Floresville	10	1,146	5.90	.5	7.6	6.1	2.33	5.9	51.2	47.1
Ft. Stockton	3	1,453	4.34	.3	1.7	2.4	.79	4.7	51.5	48.7
Giddings	4	503	5.64	.2	9.8	7.3	2.47	5.9	52.8	48.5
Gilmer	5	381	5.42	.3	2.5	4.3	.91	5.2	53.8	50.5
Grand Saline	9	636	5.83	.8	2.2	4.7	1.19	6.0	54.0	50.3
Hallettsville	3	581	5.81	.2	2.5	4.9	.72	6.3	52.7	49.0
Hillsboro	4	487	4.91	.2	3.5	5.2	1.07	5.4	53.5	50.1
Jewett	6	1,082	6.33	.1	4.6	3.1	1.34	6.7	53.3	49.1
Jourdanton	3	1,263	5.70	1.0	12.5	13.4	1.66	6.2	51.8	47.8
Keller	9	487	5.48	.1	4.1	5.1	1.21	6.1	53.8	49.9
Llano	6	1,032	5.57	.1	6.0	5.5	1.53	5.5	53.6	49.9
Malakoff	2	497	4.72	.1	1.5	2.8	.53	5.3	54.5	51.3
Mt. Pleasant	7	300	5.92	.1	2.3	5.3	1.25	6.1	54.2	50.1
Nixon	4	1,967	5.29	.3	10.1	5.1	2.66	5.7	53.0	48.6
Pontotoc	6	925	5.82	.4	3.3	4.0	1.08	6.3	53.4	49.5
San Angelo	1	740	4.05	1.1	3.3	7.6	2.20	5.5	53.2	49.2
San Antonio	6	2,011	5.57	.3	3.5	4.8	1.14	5.5	50.7	47.3
Seagraves	1	7,600	4.74	2.0	.7	5.8	2.01	4.6	54.7	51.1
Smithville	2	636	5.70	.4	4.0	3.1	1.85	5.9	54.3	50.2
Stephenville	7	303	5.25	1.1	4.2	4.5	1.60	5.8	52.5	48.7
Sulphur Springs	8	757	6.05	.2	4.1	5.4	1.26	6.1	55.7	51.6
Tatum	2	611	5.03	0	2.7	3.9	.72	5.1	53.8	50.7
Vernon	8	649	5.02	.5	2.3	5.6	1.05	5.4	55.4	51.9
Waller	3	836	5.62	.5	5.8	6.6	1.91	6.2	51.4	48.0
Weatherford	4	116	5.06	.2	5.5	3.9	1.77	4.8	51.5	48.1
Wellington	7	834	4.97	.1	1.8	2.4	.53	5.2	56.6	53.2
Whitesboro	16	392	5.64	.2	5.2	5.7	1.58	5.8	54.5	50.6
State	220	760	5.56	.4	4.7	5.0	1.52	5.8	53.6	49.7
United States	265	752	5.52	.4	4.9	5.2	1.60	5.7	53.7	49.8
Cimarron:										
Dryland:										
Arkansas:										
Van Buren	64	3,371	5.43	.2	7.5	2.5	1.70	6.1	55.7	51.4
Oklahoma:										
Altus	3	1,801	4.74	.3	3.2	4.8	1.02	5.3	52.8	47.8
Anadarko	10	1,024	5.38	1.4	5.4	5.7	2.41	5.3	54.4	50.3
Erick	8	1,072	4.78	.4	3.0	3.0	1.09	4.8	55.8	52.6
McAlester	8	1,357	5.30	.9	2.1	3.5	1.07	5.5	54.1	50.6
State	29	1,209	5.13	.9	3.6	4.3	1.53	5.2	54.5	50.8
Texas:										
Chillicothe	5	638	5.12	.6	4.1	4.7	1.51	5.4	54.2	50.5
Wellington	5	779	5.10	.1	1.7	3.0	.44	5.1	56.1	53.0
Vernon	21	1,297	5.04	.5	3.6	4.5	1.28	5.5	54.6	50.9
State	31	1,107	5.06	.4	3.4	4.3	1.18	5.4	54.8	51.2
Total dryland	124	2,299	5.27	.4	5.6	3.4	1.53	5.7	55.2	51.2
Irrigated:										
Oklahoma:										
Altus	10	2,471	4.56	.7	4.4	5.3	1.61	5.1	55.3	51.6
Texas:										
Brownwood	1	2,000	5.04	.3	10.3	3.7	2.30	5.9	55.5	51.0
Hereford	34	7,046	5.05	1.7	4.4	4.5	2.72	5.2	56.6	52.2
State	35	6,902	5.05	1.6	4.6	4.4	2.71	5.2	56.5	52.1
Total irrigated	45	5,917	4.94	1.4	4.5	4.6	2.46	5.2	56.2	52.0

Continued-

TABLE 14.--Characteristics of castorbeans, dryland and irrigated, as shown by field and laboratory analyses, by variety and hulling center, 1952 crop--Cont.

Variety and hulling center	Samples	Weight of lot	Field analysis				Laboratory analysis			
			Moisture	Free foreign material	Unhulled beans	Cracked & broken beans	Foreign material	Moisture, clean sample	Oil	
									Clean, moisture free basis	Whole sample
Cimarron--Continued										
Dryland and irrigated:	*Number*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
United States	169	3,263	5.18	0.7	5.3	3.7	1.78	5.6	55.5	51.4
Baker:										
Dryland:										
Oklahoma:										
Altus	1	2,073	4.70	2.0	5.8	4.4	1.20	4.7	51.1	48.1
Texas:										
Ft. Stockton	1	1,860	4.40	.9	3.4	1.0	1.06	4.6	49.9	47.1
Vernon	1	1,215	4.10	1.5	2.3	3.6	1.70	4.3	53.1	49.9
State	2	1,538	4.25	1.2	2.9	2.3	1.38	4.5	51.5	48.5
Total dryland	3	1,716	4.40	1.5	3.8	3.0	1.32	4.5	51.4	48.4
Irrigated:										
Arizona:										
Phoenix	3	10,667	4.83	2.1	5.5	9.6	2.86	5.4	50.0	46.0
California:										
Los Angeles	2	44,830	6.05	2.4	7.5	3.9	2.65	6.5	51.4	46.8
Texas:										
Carrizo Springs	7	3,273	5.12	.8	4.0	3.3	1.46	5.8	51.4	47.7
Crosby	1	—	4.90	3.4	1.0	16.5	3.53	4.8	52.1	47.8
Eagle Pass	5	3,474	4.78	.2	1.0	1.8	.49	5.1	51.4	48.5
Edinburg	21	3,165	5.13	.5	2.5	4.4	.86	6.1	49.8	46.3
Floydada	11	5,954	4.24	.7	6.8	4.0	1.86	4.8	51.8	48.4
Ft. Stockton	10	2,735	4.93	1.5	1.9	2.1	1.64	5.2	51.4	47.9
Friona	14	6,223	4.53	1.8	4.2	1.8	2.49	4.7	54.0	50.2
Hale Center	8	6,290	5.00	2.6	4.8	2.6	3.33	5.4	52.6	48.1
Jourdanton	1	517	5.30	1.9	6.7	5.9	1.83	6.1	50.7	46.7
Laredo	3	8,680	5.12	.1	6.8	2.0	1.56	5.6	50.4	46.8
Lehman	16	6,291	5.05	1.9	5.0	2.6	2.54	5.2	53.5	49.4
Muleshoe	11	4,558	4.42	2.5	2.2	1.6	2.50	4.6	52.3	48.7
New Deal	4	4,750	4.88	.9	3.7	2.6	1.44	4.9	53.8	50.5
Ralls	12	4,688	4.81	.5	1.4	3.0	.65	5.1	52.1	49.2
San Angelo	10	3,982	5.03	1.4	2.6	3.7	1.79	5.6	50.9	47.3
San Benito	8	1,754	5.01	.3	2.6	3.5	.63	6.1	48.5	45.4
Seagraves	14	3,504	5.44	.5	5.9	2.3	1.56	5.6	52.3	48.5
State	156	4,439	4.91	1.2	3.7	3.0	1.70	5.3	51.8	48.2
Total irrigated	161	5,057	4.92	1.2	3.7	3.1	1.73	5.4	51.7	48.1
Dryland and irrigated:										
United States	164	4,996	4.91	1.2	3.7	3.1	1.73	5.3	51.7	48.1
U. S. 74:										
Dryland:										
Oklahoma:										
Altus	9	1,296	5.21	.2	3.5	3.2	.92	5.5	54.6	51.2
Anadarko	19	1,183	5.47	1.1	4.7	3.7	1.91	5.3	55.5	51.5
Erick	3	1,991	4.62	1.2	3.5	2.6	2.11	5.0	54.0	50.3
Henryetta	9	638	5.45	1.4	4.4	2.6	1.43	5.2	53.8	50.2
Hugo	46	1,534	5.99	.5	5.4	3.8	1.53	6.0	54.0	49.9
McAlester	2	3,202	5.15	.4	2.1	1.4	.65	5.4	53.8	50.6
State	88	1,396	5.68	.7	4.8	3.5	1.54	5.7	54.3	50.5
Texas:										
Chillicothe	5	849	5.31	.8	5.4	5.0	1.74	5.7	52.5	48.6
Vernon	10	1,293	5.23	1.4	3.6	3.9	2.04	5.7	52.9	49.0
State	15	1,145	5.26	1.2	4.2	4.2	1.94	5.7	52.8	48.9
United States	103	1,359	5.62	.8	4.7	3.6	1.59	5.7	54.1	50.2
Baker 7:										
Irrigated:										
Texas:										
Hereford	9	10,078	5.23	3.6	5.2	5.0	4.55	5.6	54.0	48.5
Baker 195:										
Irrigated:										
California:										
Los Angeles	4	30,313	6.40	3.8	6.3	4.9	3.46	6.9	50.4	45.3
Texas:										
Floydada	3	7,010	4.58	.5	2.9	3.6	.85	4.9	50.8	47.9
Hale Center	10	8,538	4.81	1.1	2.8	1.8	1.43	5.2	52.2	48.7
New Deal	3	8,437	4.63	1.2	6.0	1.6	2.22	5.1	52.5	48.7
State	16	8,233	4.73	1.0	3.4	2.1	1.47	5.1	52.0	48.5
United States	20	12,649	5.07	1.6	4.0	2.7	1.87	5.5	51.7	47.9
Hybrid:										
Irrigated:										
Arizona:										
Phoenix	3	12,851	5.47	2.1	3.2	9.5	2.48	5.6	49.4	45.5

TABLE 15.—Characteristics of castorbeans, dryland and irrigated, as shown by field and laboratory analyses, by variety and hulling center, 1953 crop

Variety and hulling center	Samples	Weight of lot	Field analysis				Laboratory analysis			
			Moisture	Free foreign material	Unhulled beans	Cracked & broken beans	Foreign material	Moisture, clean sample	Oil	
									Clean, moisture free basis	Whole sample
Conner:										
Dryland:										
Oklahoma:	*Number*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Anadarko	9	1,291	5.65	0.3	6.4	7.5	1.73	5.6	53.9	49.9
Erick	4	716	5.16	.4	4.7	5.1	1.52	5.6	53.7	49.9
Henryetta	8	909	5.62	.5	3.7	5.4	1.30	6.2	52.6	48.7
Holdenville	7	941	5.70	.8	2.2	5.0	1.16	6.1	52.8	49.0
Ripley	4	1,662	5.66	.5	6.7	7.8	2.22	6.0	54.4	50.0
Rush Springs	9	672	5.53	.2	3.4	6.7	.99	6.0	54.6	50.8
State	41	1,001	5.58	.4	4.4	6.3	1.41	5.9	53.6	49.7
Texas										
Athens	9	1,175	5.42	.3	4.0	4.3	1.23	5.7	53.8	50.1
Atlanta	10	674	6.01	.2	2.9	4.4	.90	6.4	53.4	49.6
Bonham	5	1,060	5.63	.3	4.2	4.8	1.04	6.2	52.7	49.0
Brownwood	10	918	5.36	.9	4.6	4.6	1.89	5.6	54.5	50.5
Carbon	8	976	5.78	.3	2.2	4.0	.85	5.6	54.4	50.9
Chico	6	1,005	5.79	.1	2.2	4.0	.71	5.9	53.4	49.9
Clarksville	11	1,415	5.71	.3	3.6	4.5	1.28	6.2	53.7	49.7
Cross Plains	12	924	6.16	.2	3.0	4.1	.91	6.7	52.9	49.0
Devine	4	2,819	5.62	1.8	3.5	4.0	2.12	6.8	50.4	45.9
Edinburg	1	6,500	4.23	.6	3.2	20.7	1.37	5.3	53.3	49.8
Elkhart	5	1,328	5.10	.5	4.8	4.1	1.74	6.2	52.2	48.1
Floresville	7	511	5.85	.3	1.3	5.8	.47	5.6	52.0	49.0
Giddings	11	863	5.84	.1	4.9	5.8	1.32	6.0	53.4	49.6
Gilmer	9	1,132	6.13	.2	3.4	5.9	.89	6.5	54.1	50.2
Grand Saline	8	1,732	6.42	.1	2.7	4.3	.80	6.6	53.6	49.7
Grapeland	4	1,554	5.48	.2	3.4	4.1	.97	6.0	53.3	49.6
Hillsboro	14	906	5.70	.2	3.4	6.7	.97	6.2	53.7	49.9
Jewett	6	1,225	6.51	.1	3.3	3.7	.89	6.9	52.7	48.6
Joshua	8	750	6.22	.3	6.7	6.2	1.93	6.4	53.4	49.0
Jourdanton	7	849	5.75	.6	4.2	5.1	2.07	6.7	52.1	47.6
Llano	11	1,146	5.92	.9	4.3	5.2	1.65	6.4	52.9	48.7
Mt. Pleasant	10	1,086	5.33	.1	3.8	5.3	1.05	6.2	54.8	50.8
Nixon	5	1,688	5.38	.5	5.5	4.1	1.92	5.7	52.6	48.6
Pontotoc	9	1,236	4.47	.7	6.6	8.6	1.94	6.1	53.0	49.0
San Antonio	6	793	5.48	.2	5.9	7.0	1.92	5.2	52.2	49.6
Stephenville	9	579	5.32	1.3	4.4	5.6	1.88	6.6	52.6	48.2
Sulphur Springs	11	1,125	5.43	.1	4.2	6.1	1.01	6.7	54.1	50.0
Tatum	5	1,387	5.75	.2	2.6	3.8	.77	6.0	54.2	50.5
Vernon	4	2,381	5.74	.6	8.0	8.3	2.36	5.8	55.7	51.2
Weatherford	7	846	5.54	.5	4.9	5.7	1.72	5.8	53.6	49.7
Whitesboro	9	968	5.58	.2	4.5	7.5	1.84	5.8	53.2	49.2
State	241	1,114	5.68	.4	3.9	5.4	1.33	6.1	53.4	49.5
United States	282	1,098	5.67	.4	3.9	5.5	1.34	6.0	53.4	49.5
Cimarron:										
Dryland:										
Arkansas:										
Lewisville	8	837	5.83	.2	2.5	4.3	.61	5.7	56.1	52.5
Stuttgart	8	1,772	5.84	.3	4.3	4.7	1.33	5.7	54.8	51.0
Van Buren	7	2,304	5.40	.7	9.0	5.3	2.40	5.6	55.6	51.2
State	23	1,609	5.70	.4	5.1	4.8	1.41	5.7	55.5	51.6
Oklahoma:										
Anadarko	7	1,589	5.79	.3	2.6	5.3	.62	6.0	55.3	51.7
Erick	6	3,420	5.64	.3	4.6	3.2	1.23	5.9	53.6	49.9
Holdenville	5	940	5.63	.5	1.1	3.7	.62	5.9	54.2	50.7
Hugo	2	1,405	5.29	.2	6.4	6.4	1.34	6.4	57.8	53.4
Ripley	2	898	5.63	.3	4.5	5.9	1.01	6.6	54.7	50.6
Rush Springs	6	832	5.67	.2	4.0	5.4	.84	6.5	55.9	51.8
State	28	1,641	5.66	.3	3.5	4.7	.88	6.1	55.0	51.2
Texas:										
Atlanta	5	911	5.82	.2	5.8	3.3	1.30	6.1	55.2	51.2
Bonham	6	1,734	6.06	.2	3.7	5.0	.82	6.6	55.3	51.2
Carbon	1	1,070	4.74	.0	3.7	3.3	.63	5.1	54.8	52.2
Chico	2	2,280	5.85	.0	1.4	2.2	.26	6.0	54.5	51.0
Cross Plains	1	1,113	5.30	1.0	1.5	4.8	.77	5.9	57.0	53.2
Devine	2	2,148	5.68	.2	1.1	5.2	.60	6.4	53.0	49.4
Edinburg	2	5,560	5.16	.1	6.3	12.2	1.54	5.5	55.8	52.0
Elkhart	4	1,392	4.93	.2	2.6	3.6	.62	5.7	54.9	51.5
Giddings	7	1,456	6.11	.1	4.6	5.3	1.14	6.0	54.2	50.4
Gilmer	3	2,099	5.87	.2	3.6	4.0	.86	6.3	55.5	51.5
Grapeland	1	570	5.52	.1	6.2	1.2	1.40	5.6	53.6	50.0
Hillsboro	1	,446	5.63	.1	4.7	2.7	1.02	5.7	57.1	53.3
Jewett	5	1,258	6.36	.1	2.3	2.5	.68	6.7	53.5	49.6
Llano	2	1,119	5.46	.3	4.4	3.4	1.23	5.8	58.1	49.4
Nixon	3	695	5.37	.3	3.8	2.0	1.15	5.3	54.3	50.8
Pontotoc	1	1,302	5.95	.5	4.1	5.2	1.52	6.2	53.4	49.3
San Antonio	1	540	4.40	.6	13.1	3.6	3.99	4.9	48.7	44.4
Stephenville	2	602	5.61	.9	9.3	3.4	3.06	6.4	55.9	50.8
Tatum	3	1,116	5.73	.1	1.8	2.6	.62	5.8	53.8	50.3
Vernon	2	1,873	5.90	.4	4.6	7.4	1.18	6.3	55.0	51.0
Weatherford	1	2,064	5.95	.4	4.0	7.0	.95	6.1	55.1	51.2
Whitesboro	1	1,418	5.04	.0	1.2	7.2	.34	4.9	53.8	51.0
State	56	1,526	5.62	.2	4.0	4.3	1.06	6.0	54.7	50.7
Total dryland	107	1,574	5.65	.3	4.1	4.5	1.09	6.0	55.0	51.0

Continued-

TABLE 15.—Characteristics of castorbeans, dryland and irrigated, as shown by field and laboratory analyses, by variety and hulling center, 1953 crop—Continued

Variety and hulling center	Samples	Weight of lot	Field analysis				Laboratory analysis			
			Moisture	Free foreign material	Unhulled beans	Cracked & broken beans	Foreign material	Moisture clean samples	Oil	
									Clean moisture free basis	Whole sample
Cimarron—Continued										
Irrigated:										
Texas:	*Number*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Carrizo Springs	1	4,040	5.95	1.6	12.9	7.8	3.71	6.7	51.5	46.2
Brownfield	2	39,630	5.10	.4	11.6	2.7	2.77	4.9	53.9	49.8
Crystal City	4	3,023	5.57	.5	8.0	4.7	2.04	5.7	50.9	47.0
Devine	1	5,640	5.17	.2	2.5	5.2	.82	4.8	52.6	49.6
Eagle Pass	1	520	6.45	1.4	5.1	1.5	3.07	7.3	51.8	46.6
Edinburg	3	4,453	5.56	.4	4.1	10.4	1.12	5.7	55.7	52.0
Floydada	6	19,340	5.43	1.5	8.4	3.5	2.95	6.0	53.8	49.1
Ft. Stockton	3	1,967	4.97	.6	6.2	3.8	1.81	4.4	54.4	51.2
Hereford	6	4,892	4.65	.9	1.8	4.0	1.19	5.3	55.3	51.7
Llano	3	9,626	5.19	.1	4.9	2.6	1.11	5.3	53.3	49.9
Muleshoe	4	9,150	4.94	.6	3.5	6.4	1.28	5.8	54.6	50.8
Plainview	14	9,237	4.08	1.2	4.0	4.0	1.97	4.6	54.8	51.2
San Antonio	1	943	5.52	.4	3.7	5.7	1.08	5.4	50.6	47.4
State	49	9,328	4.90	.9	5.2	4.5	1.88	5.3	54.1	50.2
New Mexico:										
Tucumcari	4	3,415	5.52	1.0	9.1	6.8	2.96	5.2	55.8	51.3
Total irrigated	53	8,881	4.95	.9	5.5	4.7	1.96	5.3	54.2	50.3
Dryland and irrigated:										
United States:	160	3,994	5.41	.5	4.5	4.6	1.38	5.8	54.7	50.8
U. S. 74:										
Dryland:										
Oklahoma:										
Anadarko	8	1,056	5.71	0.2	4.9	4.1	1.06	5.4	47.3	43.8
Durant	1	Whse.	5.04	.1	4.8	7.7	1.09	5.4	52.3	48.9
Erick	4	1,515	5.46	.6	5.3	2.7	1.66	5.7	52.6	48.8
Henryetta	5	1,283	5.65	.3	5.0	2.8	1.12	5.8	51.5	48.0
Holdenville	7	988	5.66	.5	6.2	3.2	1.56	12.9	50.6	41.3
Hugo	7	1,315	5.62	.2	4.8	3.1	1.00	6.2	52.1	48.3
Ripley	5	1,709	5.40	.3	4.3	4.0	1.07	6.1	51.0	47.5
Rush Springs	8	643	5.37	.2	4.1	4.7	.94	5.9	52.8	49.3
State	45	1,128	5.55	.3	4.9	3.7	1.17	6.9	51.0	46.5
Texas:										
Atlanta	2	592	6.38	.1	1.6	1.6	.42	6.4	49.9	46.0
Bonham	6	1,041	5.75	.2	4.7	2.9	.92	6.3	50.8	47.0
Chico	2	1,254	5.10	.1	4.9	1.9	1.18	4.6	53.4	50.4
Elkhart	5	955	5.18	.3	6.4	1.9	1.61	6.3	51.5	47.5
Giddings	3	442	5.63	.1	6.1	4.1	1.27	5.6	52.8	49.2
Gilmer	2	808	5.74	.1	2.6	3.3	.51	6.2	52.3	48.8
Grand Saline	3	779	5.66	.1	2.1	2.1	.46	5.8	51.5	48.3
Grapeland	1	874	5.04	.1	6.2	1.9	1.30	5.2	51.6	48.3
Jewett	4	1,214	6.07	.2	1.4	2.1	.36	6.5	50.1	46.9
Jourdanton	3	465	5.69	.4	5.1	3.4	1.24	6.0	53.1	49.3
Mt. Pleasant	3	774	5.40	.1	3.5	3.3	.67	5.9	52.1	48.8
San Antonio	3	1,822	5.11	.2	7.6	3.1	1.71	5.2	49.8	46.4
Sulphur Springs	6	683	5.30	.1	8.8	2.9	1.72	6.5	53.4	49.1
Tatum	2	925	5.79	.0	1.4	2.1	.26	5.8	52.0	48.9
Vernon	3	1,880	5.56	.5	7.6	4.4	1.69	5.5	53.3	49.5
Whitesboro	3	1,176	5.58	.3	4.9	5.4	1.19	6.1	53.5	49.6
State	51	980	5.56	.2	5.0	2.9	1.10	6.0	51.9	48.3
Total dryland	96	1,050	5.55	.2	5.0	3.3	1.13	6.4	51.5	47.5
Irrigated:										
New Mexico:										
Tucumcari	1	6,362	5.30	.3	6.1	5.5	1.38	4.8	56.3	52.8
Dryland and irrigated:										
United States	97	1,104	5.55	.2	5.0	3.3	1.14	6.4	51.5	47.5
Hybrid 4:										
Dryland:										
Texas:										
Atlanta	2	778	5.63	.2	2.9	3.4	.67	5.9	47.7	47.0
Giddings	2	808	5.32	.4	2.0	3.4	.62	5.4	49.5	46.4
Llano	1	1,095	6.45	.2	3.3	3.3	1.31	7.0	52.8	48.5
Tatum	2	1,150	5.95	.1	1.1	2.7	.31	5.9	49.8	46.8
State	7	938	5.75	.2	2.2	3.2	.64	5.9	50.1	46.8
Irrigated:										
Texas:										
Carrizo Springs	2	5,220	5.21	1.8	4.1	4.5	2.08	5.4	48.0	44.4
Crystal City	1	6,150	5.52	.5	8.3	3.8	2.53	5.7	50.2	46.2
Muleshoe	1	4,600	5.41	1.3	2.9	3.8	2.05	5.6	51.4	47.5
San Antonio	2	820	5.40	.1	7.1	6.7	1.30	5.4	51.2	47.9
State	6	3,805	5.36	.9	5.6	5.0	1.89	5.5	50.0	46.4
New Mexico:										
Tucumcari	2	2,359	5.34	.8	5.9	6.9	2.02	4.9	54.9	51.1
Total irrigated	8	3,444	5.36	.9	5.7	5.5	1.92	5.3	51.2	47.6
Dryland and irrigated:										
United States	15	2,275	5.54	.6	4.1	4.4	1.33	5.6	50.7	47.2

Continued-

TABLE 15.—Characteristics of castorbeans, dryland and irrigated, as shown by field and laboratory analyses, by variety and hulling center, 1953 crop—Continued

Variety and hulling center	Samples	Weight of lot	Field analysis				Laboratory analysis			
			Moisture	Free foreign material	Unhulled beans	Cracked & broken beans	Foreign material	Moisture, clean samples	Oil	
									Clean moisture free basis	Whole sample
Baker 1:										
Dryland:										
Texas:	*Number*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Edinburg	3	1,304	4.46	0.4	4.9	3.0	1.33	5.3	50.0	46.8
Irrigated:										
Texas:										
Carrizo Springs	7	11,160	5.49	.8	6.0	2.8	1.90	6.2	49.8	45.8
Brownfield	2	6,390	5.30	.4	9.4	2.4	1.87	4.9	52.9	49.4
Crystal City	7	7,267	5.90	.8	6.9	3.3	2.16	6.0	50.4	46.3
Eagle Pass	1	1,560	5.95	.1	2.8	1.8	.87	6.6	50.7	46.8
Muleshoe	2	44,185	4.04	.4	5.8	1.9	1.50	5.0	52.6	49.2
Total irrigated	19	12,195	5.49	.7	6.5	2.8	1.37	5.9	50.7	46.8
Dryland and irrigated:										
United States	22	11,066	5.35	.6	6.3	2.8	1.82	5.8	50.6	46.8
Baker 195:										
Dryland:										
Texas:										
Giddings	1	548	5.95	.2	5.9	5.7	1.26	6.0	49.0	45.4
Irrigated:										
Texas:	1	2,300	5.04	1.3	2.1	2.3	1.40	5.5	49.5	46.1
United States	2	1,424	5.50	.8	4.0	4.0	1.33	5.8	49.3	45.8
Mixed varieties:										
Dryland:										
Texas:										
Chico	1	---	5.95	.5	3.4	4.4	1.18	6.2	52.3	48.5
Jewett	3	1,765	6.74	.4	1.9	5.6	.81	7.9	53.2	48.6
State	4	441	6.54	.4	2.3	5.3	.90	7.5	53.0	48.6
Irrigated:										
Texas:										
Brownfield	1	6,680	5.04	.8	1.3	4.4	.48	4.9	52.8	50.0
Floydada	2	57,575	5.04	1.9	6.4	5.5	2.64	5.6	57.9	48.7
State	3	63,562	5.04	1.5	4.7	5.1	1.92	5.3	56.2	49.1
Dryland and irrigated:										
United States	7	18,161	5.90	.9	3.3	5.2	1.34	6.6	54.4	48.8

TABLE 16.--Characteristics of castorbeans, dryland and irrigated, as shown by field and laboratory analyses, by variety and hulling center, 1954 crop

Variety and hulling center	Samples	Weight of lot	Field analysis				Laboratory analysis			
			Moisture	Free foreign material	Unhulled beans	Cracked & broken beans	Foreign material	Moisture, clean sample	Oil	
									Clean, moisture free basis	Whole sample
Cimarron:										
Dryland:										
Arkansas	*Number*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Earle........................	4	2,396	5.96	0.5	8.0	4.4	2.04	6.5	53.6	49.2
Corning......................	4	1,199	5.46	.2	5.8	5.6	1.29	5.8	53.7	49.9
State......................	8	1,798	5.71	.3	6.8	5.0	1.66	6.2	53.7	49.6
Missouri										
Holcomb......................	4	949	8.06	.1	8.7	6.4	1.68	6.5	54.2	49.9
Oklahoma										
Cheyenne.....................	10	936	5.50	1.0	4.4	5.2	2.62	5.2	54.3	50.0
Erick........................	10	1,921	5.09	.8	3.0	3.7	1.50	4.9	55.2	51.7
State......................	20	1,428	5.30	.9	3.7	4.5	2.06	5.0	54.7	50.9
Texas										
Ballinger....................	12	1,136	4.90	.9	3.5	5.7	1.92	5.0	52.9	49.3
Colo. City...................	10	3,450	4.87	.7	4.8	6.4	1.68	4.7	54.5	51.0
Vernon.......................	5	1,114	5.28	.7	3.8	4.4	2.26	4.5	55.5	51.8
State......................	27	1,989	4.96	.8	4.0	5.7	1.89	4.8	54.0	50.4
Total dryland......................	59	1,703	5.38	.7	4.6	5.2	1.90	5.2	54.2	50.4
Irrigated:										
New Mexico										
Roswell......................	10	3,520	4.90	1.0	6.8	6.3	2.44	4.8	54.7	50.8
Texas										
Vernon.......................	1	---	5.20	1.0	2.8	4.3	1.56	5.0	55.5	51.9
Total irrigated....................	11	3,520	4.92	1.0	6.4	6.2	2.36	4.8	54.8	50.9
Dryland and irrigated:										
United States......................	70	1,966	5.31	.7	4.9	5.4	1.98	5.1	54.4	50.5
Conner:										
Dryland:										
Oklahoma										
Anadarko.....................	12	940	5.17	.5	3.3	8.6	1.39	5.2	55.5	52.0
Texas										
Clarksville..................	11	1,021	5.89	.2	3.1	3.3	1.09	6.8	54.3	50.1
Elkhart......................	10	864	5.22	.3	4.0	6.8	1.28	6.4	54.3	50.2
Hillsboro....................	12	658	5.27	.2	6.2	6.9	1.79	5.7	54.3	50.3
Pontotoc.....................	1	2,491	4.57	.3	3.5	6.2	1.30	5.6	53.4	49.8
Stephenville.................	8	600	4.16	.8	7.6	9.2	3.00	5.7	53.2	48.6
Sulphur Springs..............	9	760	4.81	.2	3.7	7.1	1.14	6.7	54.5	50.3
State......................	51	817	5.12	.3	4.8	6.5	1.61	6.2	54.1	50.0
United States......................	63	826	5.13	.3	4.5	6.9	1.56	6.0	54.4	50.3
Baker:										
Dryland:										
Texas:										
Muleshoe.....................	7	17,303	3.36	.9	8.0	3.4	2.46	4.5	52.1	48.5
Irrigated:										
Texas:										
Muleshoe.....................	4	11,260	3.66	.9	8.8	3.3	2.73	4.9	52.0	48.2
State......................	11	15,105	3.47	.9	8.3	3.4	2.55	4.7	52.1	48.4
Mixed varieties:										
Dryland:										
Texas:										
Plainview....................	6	7,340	3.35	1.6	4.1	4.5	2.03	4.0	53.0	49.9
Irrigated:										
Texas:										
Plainview....................	2	9,040	4.70	.8	6.0	4.8	1.86	4.8	52.0	48.6
State......................	8	7,765	3.69	1.4	4.6	4.6	1.99	4.2	52.8	49.6
Hybrid 4:										
Irrigated:										
New Mexico:										
Las Cruces...................	11	9,866	4.78	.8	2.6	5.0	1.2[illegible]	5.0	51.7	48.5
Hybrid 7:										
Irrigated:										
New Mexico:										
Lemitar......................	10	7,991	4.88	2.6	7.0	8.1	4.27	5.1	54.0	49.0
Otis.........................	10	6,371	4.84	.4	1.9	3.9	.74	5.0	52.1	49.1
State......................	20	7,181	4.86	1.5	4.5	6.0	2.51	5.1	53.1	49.1

TABLE 17.--Chemical analysis of samples of Conner variety castorbeans and of the oil extracted from them, the beans having been taken from storage at Whitesboro, Tex., 1953 and 1954[1]

100-percent whole beans

Sample No.	Date sample was drawn	Months in storage	Castorbean analysis			Castor oil analysis					
			Moisture clean sample	Oil		Specific gravity	Color (Gardner)	Neutralization number	Free fatty acid (as oleic)	Iodine no.	Unsaponifiable matter
				Clean moisture free	Whole sample						
	1953	*Number*	*Percent*	*Percent*	*Percent*	*Percent*	*Number*		*Percent*		*Percent*
1	2-20	5	6.4	54.6	51.2	0.962	3	0.67	0.34	86	0.37
2	3-26	6	5.9	54.5	51.3	.961	3	.48	.24	85	.49
3	4-14	6-1/2	5.5	52.6	49.7	.962	3	.52	.26	87	.42
4	4-29	7	5.8	53.8	50.7	.961	3	.82	.41	86	.38
5	5-15	7-1/2	5.7	54.7	51.6	.959	3	.82	.41	88	.60
6	5-29	8	5.4	53.2	50.4	.960	2	.16	.08	86	.48
7	6-15	8-1/2	5.2	54.3	51.5	.959	3	.64	.32	87	.59
8	6-30	9	4.9	54.3	51.7	.961	2	.83	.42	88	.62
9	7-15	9-1/2	5.0	53.2	50.5	.965	2	1.05	.53	86	.70
10	7-31	10	5.0	53.8	51.1	.959	3	.55	.28	88	.57
11	8-15	10-1/2	6.7	55.8	52.1	.959	2	.97	.49	86	.41
12	8-31	11	5.3	53.3	50.4	.963	2	.58	.28	86	.28
13	9-15	11-1/2	4.8	53.9	51.3	.962	2	.67	.35	87	.46
14	10-6	12	4.8	54.2	51.2	.965	2	.26	.13	89	.57
15	10-20	12-1/2	4.8	54.7	52.1	.964	3	.62	.31	83	.77
16	11-3	13	5.2	52.2	49.4	.961	3	.57	.29	83	.64
17	11-30	14	5.5	53.4	50.5	.961	2	.74	.37	86	.55
18	12-31	15	5.5	54.2	51.2	.964	4	.66	.33	87	.21
	1954										
19	1-25	16	5.6	54.5	51.4	.963	3	.80	.40	87	.52
20	2-23	17	5.5	54.8	51.8	.962	3	.52	.26	87	.39
21	3-29	18	5.5	54.5	51.5	.964	2	.60	.30	86	.53
22	4-15	18-1/2	5.9	54.1	50.9	.962	3	.56	.28	86	.64
23	5-3	19	6.1	56.7	53.2	.962	2	.47	.24	87	.55
24	5-14	19-1/2	6.1	53.2	50.0	.962	3	.54	.27	89	.64
25	6-1	20	6.4	54.7	51.2	.961	3	.53	.27	89	.59
26	6-14	20-1/2	5.9	53.9	50.7	.961	3	.61	.30	86	.63
27	7-12	21-1/2	4.6	52.3	49.9	.961	3	.63	.32	87	.67
28	8-2	22	5.7	53.9	50.8	.961	4	.89	.45	87	.71
29	8-17	22-1/2	4.9	54.0	51.4	.960	2	.85	.43	85	.78
30	9-2	23	5.0	54.4	51.7	.961	3	.98	.50	86	.55
31	9-14	23-1/2	4.6	53.7	51.2	.960	3	1.04	.52	87	.55
32	10-4	24	6.3	53.1	49.7	.962	3	1.04	.52	85	.60
Average			5.5	54.0	51.0	.962	3	.68	.34	86	.55
100-percent cracked and broken beans											
	1953										
1	2-20	5	5.7	58.9	55.6	0.961	3	.67	.34	87	.49
2	3-26	6	5.4	60.6	57.3	.960	3	.83	.42	85	.43
3	4-14	6-1/2	5.2	58.6	55.6	.963	2	.78	.39	86	.53
4	4-29	7	5.4	57.8	54.6	.964	3	.75	.35	86	.41
5	5-15	7-1/2	5.3	59.2	56.1	.964	3	.88	.44	86	.59
6	5-29	8	4.8	58.4	55.6	.960	2	.30	.15	85	.51
7	6-15	8-1/2	4.8	58.3	55.5	.961	3	.82	.41	87	.63
8	6-30	9	4.6	57.3	54.7	.959	2	.66	.33	87	.64
9	7-15	9-1/2	4.5	59.2	56.6	.963	2	.87	.44	88	.69
10	7-31	10	4.6	59.2	56.4	.961	3	1.20	.60	88	.47
11	8-15	10-1/2	4.7	58.7	55.9	.961	2	.72	.36	86	.31
12	8-31	11	4.8	58.8	56.0	.963	2	.94	.47	86	.52
13	9-15	11-1/2	4.4	58.0	55.4	.961	2	.60	.30	87	.56
14	10-6	12	4.5	58.6	55.2	.958	2	.66	.33	85	.46
15	10-20	12-1/2	4.3	59.4	56.8	.963	3	1.03	.52	82	.49
16	11-3	13	4.8	57.8	55.0	.962	3	.87	.44	83	.58
17	11-30	14	4.8	59.6	56.6	.956	2	1.18	.59	85	.53
18	12-31	15	5.0	58.2	55.2	.962	4	1.10	.55	87	.48
	1954										
19	1-25	16	5.2	59.0	56.0	.962	4	.76	.38	87	.37
20	2-23	17	4.9	58.6	55.7	.962	2	.88	.44	88	.48
21	3-29	18	5.1	59.7	56.7	.962	2	.90	.45	87	.55
22	4-15	18-1/2	5.5	59.1	55.9	.962	3	.99	.50	88	.58
23	5-3	19	5.6	58.7	55.4	.962	2	.92	.46	87	.47
24	5-14	19-1/2	5.5	59.2	55.9	.962	3	1.05	.53	87	.54
25	6-1	20	5.8	58.8	55.4	.962	3	1.09	.55	89	.55
26	6-14	20-1/2	7.4	60.2	55.7	.961	2	1.17	.58	86	.41
27	7-12	21-1/2	3.8	62.0	59.7	.964	4	2.46	1.24	86	.74
28	8-2	22	5.1	61.2	58.0	.964	5	2.22	1.12	87	.63
29	8-17	22-1/2	4.4	58.0	55.5	.962	3	1.62	.81	84	.70
30	9-2	23	4.7	59.0	56.3	.961	4	2.16	1.09	87	.65
31	9-14	23-1/2	4.5	59.7	57.1	.962	3	2.79	1.40	87	.56
32	10-4	24	5.4	58.8	55.7	.964	4	2.56	1.28	85	.48
Average			5.0	59.0	56.0	.962	3	1.14	.57	86	.53

Continued-

See footnote at end of table.

TABLE 17.--Chemical analysis of samples of Conner variety castorbeans and of the oil extracted from them, the beans having been taken from storage at Whitesboro, Tex., 1953 and 1954[1]--Continued

Cracked and broken and whole beans

Sample No.	Date sample was drawn	Months in storage	Castorbean analysis			Castor oil analysis					
			Moisture clean sample	Oil		Specific gravity	Color (Gardner)	Neutralization number	Free fatty acid (as oleic)	Iodine no.	Unsaponifiable matter
				Clean moisture free	Whole sample						
	1953	*Number*	*Percent*	*Percent*	*Percent*	*Percent*	*Number*		*Percent*		*Percent*
1	2-20	5	6.2	54.8	49.9	0.966	3	0.47	0.24	85	0.36
2	3-26	6	5.8	55.4	51.3	.964	3	.56	.28	84	.43
3	4-14	6-1/2	5.6	54.8	50.6	.960	3	.49	.24	86	.61
4	4-29	7	5.9	54.6	49.8	.962	3	.90	.45	86	.36
5	5-15	7-1/2	5.6	55.6	51.9	.961	3	.74	.37	82	.57
6	5-29	8	5.4	55.0	50.9	.963	2	.23	.12	87	.67
7	6-15	8-1/2	4.9	54.7	52.1	.962	3	.54	.27	87	.51
8	6-30	9	5.0	54.0	51.3	.958	2	.74	.37	87	.66
9	7-15	9-1/2	5.1	55.0	52.2	.961	2	.58	.29	86	.59
10	7-31	10	5.0	53.8	50.5	.961	3	.92	.46	88	.56
11	8-15	10-1/2	5.7	54.3	50.2	.961	2	.76	.38	88	.38
12	8-31	11	5.1	54.0	51.2	.960	2	.56	.28	86	.27
13	9-15	11-1/2	4.8	54.8	51.6	.965	2	.68	.34	87	.42
14	10-6	12	4.8	54.2	50.3	.962	2	.30	.15	84	.57
15	10-20	12-1/2	4.8	54.2	50.4	.964	3	.68	.34	83	.44
16	11-3	13	5.2	53.7	49.4	.962	3	.58	.29	83	.61
17	11-30	14	5.8	54.0	50.6	.959	3	.72	.36	86	.41
18	12-31	15	5.4	54.2	51.3	.962	3	.76	.38	88	.38
	1954										
19	1-25	16	5.6	54.6	51.0	.963	3	.69	.35	87	.65
20	2-23	17	5.4	55.2	51.4	.962	2	.47	.24	88	.56
21	3-29	18	5.4	55.0	51.7	.962	2	.64	.32	87	.76
22	4-15	18-1/2	5.9	54.0	49.8	.963	3	.62	.31	87	.73
23	5-3	19	6.0	55.4	51.4	.962	2	.46	.23	87	.45
24	5-14	19-1/2	6.3	55.1	51.0	.963	3	.68	.34	88	.66
25	6-1	20	6.3	54.3	50.4	.962	3	.51	.26	88	.59
26	6-14	20-1/2	5.9	54.6	50.5	.961	3	.68	.34	88	.55
27	7-12	21-1/2	5.0	55.5	52.3	.961	3	.82	.41	87	.73
28	8-2	22	5.6	54.0	49.8	.961	4	.96	.48	87	.70
29	8-17	22-1/2	5.2	54.2	51.0	.964	3	.96	.48	87	.56
30	9-2	23	4.9	53.8	49.8	.961	3	1.15	.57	87	.54
31	9-14	23-1/2	4.8	53.8	50.3	.961	3	1.50	.76	89	.57
32	10-4	24	5.5	55.0	51.1	.963	4	1.30	.65	85	.39
Average			5.4	54.6	50.8	.962	3	.71	.35	86	.54
			Whole, cracked and broken, and beans with hulls attached								
	1953										
1	2-20	5	5.9	54.8	50.6	.960	3	.61	.31	86	.45
2	3-26	6	5.5	53.9	50.3	.961	3	.54	.27	86	.36
3	4-14	6-1/2	5.3	54.8	51.0	.963	3	.60	.30	86	.56
4	4-29	7	5.6	55.0	51.3	.963	4	1.02	.51	86	.44
5	5-15	7-1/2	5.4	53.8	50.1	.964	3	1.38	.69	86	.57
6	5-29	8	5.2	54.9	51.8	.960	2	.25	.13	84	.45
7	6-15	8-1/2	4.9	54.4	50.2	.959	3	.48	.24	88	.58
8	6-30	9	5.1	54.0	50.6	.958	2	.47	.24	88	.61
9	7-15	9-1/2	5.2	54.2	50.9	.964	2	.57	.28	88	.70
10	7-31	10	5.0	54.6	50.7	.961	3	.81	.40	88	.56
11	8-15	10-1/2	5.2	55.3	51.8	.961	2	.69	.35	86	.51
12	8-31	11	5.2	53.9	50.9	.963	2	.32	.16	86	.29
13	9-15	11-1/2	4.8	53.8	50.6	.962	4	.65	.33	87	.42
14	10-6	12	4.9	53.8	50.4	.963	2	.38	.19	86	.49
15	10-20	12-1/2	4.8	55.0	51.2	.965	3	.59	.29	83	.53
16	11-3	13	5.2	54.1	51.0	.965	3	.64	.32	83	.70
17	11-30	14	5.0	54.0	50.2	.963	3	.48	.24	87	.53
18	12-31	15	5.4	54.2	51.3	.959	3	.73	.37	88	.22
	1954										
19	1-25	16	5.4	53.6	49.8	.959	3	.64	.32	86	1.09
20	2-23	17	5.7	55.4	51.2	.961	2	.48	.24	88	.47
Average			5.2	54.4	50.8	.962	3	.62	.31	86	.53

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[1] Castorbeans placed in storage October 1952. Each sample consisted of 300 grams.

TABLE 18.—Chemical analysis of whole and of cracked and broken castorbeans and of the oil extracted from them, by storage center and variety, 1952 crop

Storage center, variety, and condition of beans	Months in storage	Castorbean analysis			Castor oil analysis					
		Moisture clean sample	Oil		Specific gravity	Color (Gardner)	Neutralization number	Free fatty acid (as oleic)	Iodine number	Unsaponifiable matter
			Clean moisture free	Whole sample						
Hugo, Okla.:										
U. S. 74:	*Number*	*Percent*	*Percent*	*Percent*	*Percent*	*Number*		*Percent*		*Percent*
Whole	4	6.1	55.1	51.7	0.963	3	0.52	0.26	86	0.51
do	5	6.2	56.3	52.8	.964	3	.40	.20	87	.48
Cracked and broken	4	5.2	64.0	60.7	.961	2	.84	.42	86	.57
do	5	5.3	65.0	61.5	.961	2	.50	.25	86	.49
Whitesboro, Tex.:										
Conner:										
Whole	4	6.4	54.1	50.6	.962	1	.23	.12	86	.51
do	5	6.2	53.8	50.4	.963	2	.32	.16	86	.55
Cracked and broken	4	5.7	51.4	48.4	.959	1	.55	.28	85	.55
do	4	5.3	62.6	59.3	.960	2	.50	.25	87	.63
Hillsboro, Tex.:										
Conner:										
Whole	3	5.2	55.4	52.5	.962	2	.35	.17	86	.50
do	3-1/2	6.0	56.1	52.8	.960	2	.36	.18	87	.37
Cracked and broken	3	4.7	59.6	56.8	.962	1	.53	.26	85	.54
do	3-1/2	5.4	58.2	55.0	.960	2	.34	.17	87	.59
Friona, Tex.:										
Baker 1:										
Whole	2	4.4	53.7	51.2	.962	2	.48	.24	79	.47
do	3	4.3	55.1	52.8	.961	2	.43	.22	85	.43
Cracked and broken	2	4.0	59.4	57.0	.962	2	.62	.31	79	.47
Hale Center, Tex.:										
Baker 195:										
Whole	2	4.9	52.7	50.1	.964	2	.40	.20	82	.51
do	3	4.7	53.0	50.5	.957	1	.36	.18	83	.48
Cracked and broken	2	4.1	60.9	57.8	.962	1	.65	.33	84	.60
do	3	4.5	64.2	60.6	.962	3	.65	.33	85	.48
Sulphur Springs, Tex.:										
Conner:										
Whole	4	6.3	54.3	50.9	.962	2	.50	.25	83	.43
do	5	6.0	55.0	51.7	.961	2	.29	.15	86	.51
Cracked and broken	4	5.5	58.5	55.3	.962	2	.53	.27	84	.47
do	5	5.2	63.5	60.2	.962	2	.53	.27	86	.64
Elkhart, Tex.:										
Conner:										
Whole	3	5.7	54.4	51.3	.964	3	.69	.35	85	.44
Cracked and broken	3	5.1	62.0	58.9	.962	2	.62	.31	86	.45
Average of all areas and varieties:										
Whole		5.68	54.49	51.38	.962	2.1	.408	.205	84.7	.480
Cracked and broken		5.00	60.78	57.63	.961	1.8	.572	.288	85.0	.540
Cracked and broken minus whole.		-0.68	+6.29	+6.25	-.004	-0.3	+0.164	+0.083	+00.3	+0.060

TABLE 19.--Analysis of variation in grade factors of farmers' lots of castorbeans, by variety and State, 1951-54 crops

Variety, State, and marketing year	Free foreign material		Attached foreign material		Total foreign material		Cracked and broken beans		Moisture		Grading deduction	
	Average	Relative variation[1]	Average	Relative variation[1]	Average	Relative variation[1]	Average	Relative variation[1]	Average	Relative variation[1]	Average	Relative variation[1]
Conner:												
Oklahoma:	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1951	1.33	102	3.52	76	4.83	60	3.64	42	6.37	22	5.45	57
1952	.70	179	1.65	70	2.36	77	5.20	27	5.33	11	2.36	80
1953	.41	168	1.08	69	1.49	72	4.27	35	5.87	13	1.85	70
1954	.69	126	1.11	64	1.80	66	7.06	33	5.41	10	2.24	60
Texas:												
1951	2.02	261	1.61	64	3.64	140	2.97	57	5.70	16	3.69	136
1952	.41	183	1.22	72	1.63	77	4.70	41	5.68	13	1.65	95
1953	.51	212	1.07	66	1.58	97	4.42	40	5.47	19	1.89	91
1954	.39	136	1.20	65	1.58	65	5.85	52	5.43	17	1.99	63
United States:												
1951	1.65	227	2.64	86	4.27	97	3.33	49	6.06	20	4.63	93
1952	.47	189	1.31	73	1.78	80	4.80	38	5.60	14	1.79	94
1953	.47	200	1.08	68	1.55	88	4.36	38	5.65	17	1.88	84
1954	.51	137	1.16	66	1.67	66	6.32	45	5.37	14	2.09	62
Cimarron:												
Arkansas:												
1952	.23	113	1.84	59	2.07	56	3.01	39	5.37	23	1.84	86
1953	.37	95	.77	81	1.15	65	2.96	41	6.03	16	1.50	77
1954	1.55	109	1.29	63	2.84	65	5.53	61	6.21	13	3.52	62
New Mexico:												
1953 (Irrigated)	1.01	139	1.83	52	2.86	63	4.87	30	5.65	4	3.06	60
1954 (Irrigated)	1.70	101	1.36	61	3.08	65	5.75	40	4.96	10	3.36	63
Oklahoma:												
1952	1.26	121	1.23	65	2.48	81	4.97	57	5.34	28	2.43	92
1953	.49	147	.90	111	1.38	106	3.11	45	6.19	11	1.76	94
1954	1.08	106	.89	75	1.97	131	4.77	46	5.48	10	2.18	68
Texas:												
1952	1.97	160	1.34	99	3.32	112	5.69	71	5.08	47	3.42	122
1953 (Dryland)	.22	136	1.11	137	1.33	65	3.75	55	5.66	18	1.71	92
1953 (Irrigated)	1.11	108	.91	104	2.02	86	3.40	45	5.13	15	2.18	91
1954	.73	126	1.17	70	1.90	63	4.25	46	5.29	14	2.11	63
United States:												
1952	1.27	169	1.38	78	2.66	97	4.81	66	5.28	33	2.62	112
1953	.52	148	.93	102	1.44	99	3.23	46	6.01	14	1.80	90
1954	1.06	117	1.28	79	2.34	70	5.12	47	5.82	20	2.94	70
U. S. 74:												
New Mexico:												
1953 (Irrigated)	.91	107	1.63	54	2.54	57	4.96	31	5.59	8	2.78	52
Oklahoma:												
1952	.77	160	1.02	65	1.79	80	3.17	45	5.68	15	1.53	101
1953	.49	133	1.04	71	1.52	66	2.92	99	5.69	22	1.68	71
1954	.69	91	.97	72	1.66	57	3.43	47	5.38	16	1.84	60
Texas:												
1952	1.29	109	.97	65	2.26	67	3.14	35	5.16	9	1.87	80
1953	.22	118	1.52	64	1.73	60	2.10	51	5.56	16	1.91	56
1954	.65	54	1.20	10	1.85	24	3.85	10	5.60	11	2.05	17
United States:												
1952	.80	155	1.02	65	1.81	80	3.17	44	5.65	14	1.55	100
1953	.52	137	1.13	71	1.65	68	3.13	89	5.67	21	1.82	70
1954	.69	90	.98	70	1.67	56	3.44	47	5.39	16	1.84	60
Baker 1:												
Texas:												
1952 (Irrigated)	1.48	97	.93	87	2.41	73	3.03	70	5.08	15	2.09	86
1953 (Irrigated)	1.33	138	1.43	84	2.76	82	3.20	51	5.08	13	2.91	84
All varieties:												
Arkansas:												
1952	.23	113	1.84	59	2.07	56	3.01	39	5.37	23	1.84	86
1953	.37	95	.77	81	1.15	65	2.96	41	6.03	16	1.50	77
1954	1.55	109	1.29	63	2.84	65	5.53	61	6.21	13	3.52	62
New Mexico:												
1953 (Irrigated)	.92	111	1.69	55	2.61	58	5.06	32	5.60	7	2.86	53
1954	1.27	122	1.13	71	2.41	80	5.10	44	4.84	10	2.63	77
Oklahoma:												
1951	1.33	102	3.52	76	4.83	60	3.64	42	6.37	22	5.45	57
1952	.74	170	1.56	71	2.29	79	4.95	33	5.35	13	2.26	83
1953	.45	153	1.03	79	1.48	77	3.68	55	5.89	16	1.79	75
1954	1.00	113	.94	73	1.94	73	5.07	48	5.45	10	2.19	68
Texas:												
1951	2.02	261	1.61	64	3.64	140	2.97	57	5.70	16	3.69	136
1952	.51	182	1.20	73	1.70	81	4.58	43	5.62	14	1.70	96
1953 (Dryland)	.53	209	1.10	68	1.63	96	4.28	43	5.48	18	1.93	91
1953 (Irrigated)	1.26	205	1.05	97	2.31	91	3.67	54	5.05	16	2.53	99
1954	.60	133	1.19	68	1.79	64	4.86	54	5.26	16	2.08	62
United States:												
1951	1.65	227	2.64	86	4.27	97	3.33	49	6.06	20	4.63	93
1952	.56	180	1.28	74	1.84	81	4.65	42	5.56	14	1.82	95
1953	.50	182	1.07	76	1.57	87	3.93	51	5.70	17	1.88	83
1954	1.09	144	1.31	31	2.40	86	5.56	57	5.64	20	2.95	83

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[1] Coefficient of variation.

TABLE 20.--Analysis of variation in grade factors of farmers' lots of Conner castorbeans, by hulling center, 1951-53 crops

Hulling center and crop year	Marketing period		Lots	Gross weight[1]		Free foreign material		Attached foreign material		Total foreign material		Cracked and broken beans		Moisture		Grading deduction	
	From	To		Total	Average	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]
Oklahoma:																	
Anadarko			*Number*	*Pounds*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1952.........	9-3-52	1-30-53	1,131	1,028,124	909	0.51	137	1.45	93	1.96	81	5.21	30	5.36	9	1.97	83
1953.........	8-27-53	12-30-53	1,332	1,504,383	1,129	.27	130	1.21	68	1.47	67	4.23	38	6.04	13	1.90	64
Ardmore																	
1951.........	8-22-51	1-15-52	227	125,082	551	1.31	75	2.07	66	3.34	49	3.37	10	5.62	13	3.47	51
1952.........	9-2-52	2-9-53	95	111,408	1,173	1.04	133	1.75	39	2.79	53	5.09	32	5.15	9	2.73	51
Henryetta																	
1951.........	9-11-51	1-4-52	599	450,368	752	1.00	141	4.28	73	5.29	62	3.88	43	6.58	12	6.10	56
1952.........	8-28-52	12-11-52	358	304,712	851	1.99	132	2.20	45	4.19	71	4.99	19	5.74	9	4.22	71
1953.........	8-26-53	1-9-54	403	424,889	1,054	.62	134	1.12	65	1.73	74	3.81	28	5.67	26	2.04	75
Rush Springs																	
1952.........	9-2-52	9-22-52	244	257,067	1,054	.26	85	1.58	50	1.84	45	5.79	23	5.27	9	1.94	46
1953.........	8-25-53	1-27-54	1,511	1,495,023	989	.31	155	1.02	62	1.33	65	4.66	27	5.75	5	1.65	63
Ripley																	
1951.........	9-13-51	12-31-51	280	224,981	804	2.04	61	3.09	53	5.12	43	3.38	51	6.52	13	5.68	44
1952.........	8-29-52	1-15-53	404	376,765	933	.62	113	1.57	82	2.19	63	5.10	29	5.31	14	2.21	74
1953.........	8-24-53	1-30-54	239	257,613	1,078	.43	81	.97	104	1.39	89	3.92	41	5.80	16	1.72	85
Texas:																	
Atlanta																	
1952.........	9-2-52	12-30-52	331	269,561	814	.37	192	.64	106	1.01	116	4.13	51	5.86	11	.96	146
1953.........	8-10-53	12-18-53	572	498,911	872	.26	331	.49	94	.75	160	4.52	44	6.09	14	1.23	128
Brownwood																	
1951.........	9-13-51	1-11-52	402	225,363	561	3.42	228	1.92	60	5.32	139	2.64	33	5.35	16	5.19	145
1952.........	8-18-52	1-30-53	150	89,140	594	.92	200	1.76	67	2.68	77	5.37	32	5.29	14	2.73	86
1953.........	8-13-53	1-23-54	246	217,775	885	1.14	120	1.23	76	2.36	79	4.25	36	5.44	13	2.59	80
Elkhart																	
1952.........	8-12-52	1-20-53	1,187	1,011,153	852	.57	200	1.11	93	1.68	95	4.58	30	5.91	16	1.75	104
1953.........	8-13-53	1-8-54	1,674	1,758,600	1,051	.32	340	1.03	55	1.34	111	3.54	30	5.22	13	1.50	109
Floresville																	
1952.........	7-28-52	1-31-53	804	666,988	830	.58	179	1.61	60	2.19	79	5.40	34	6.10	10	2.48	82
1953.........	7-8-53	1-22-54	124	84,649	683	.41	98	.76	72	1.17	65	4.40	35	6.14	9	1.58	59
Giddings																	
1952.........	7-30-52	1-26-53	583	355,006	609	.22	241	1.52	53	1.73	58	5.38	45	5.85	13	1.90	66
1953.........	7-20-53	1-27-54	541	495,539	916	.11	254	1.13	42	1.24	45	5.10	30	5.90	31	1.79	53
Stephenville																	
1951.........	9-28-51	1-16-52	520	261,537	503	1.03	128	1.45	61	2.47	64	3.30	62	6.01	14	2.70	73
1952.........	8-15-52	1-31-53	995	562,257	565	.54	100	1.08	64	3.59	27	3.47	24	5.38	12	1.30	100
1953.........	8-12-53	1-29-54	1,184	1,056,544	892	.96	123	1.39	58	2.34	70	5.36	37	5.15	18	2.68	68

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[1] Gross pounds delivered before grading deduction.
[2] Coefficient of variation.

TABLE 21.--Analysis of variation in grade factors of farmers' lots of castorbeans, by variety and hulling center, 1952 and 1953 crops

Variety, hulling center, and crop year	Marketing period		Farmers' lots hulled			Free foreign material		Attached foreign material		Total foreign material		Cracked and broken beans		Moisture		Grading deduction	
				Weight[1]													
	From	To	Number	Total	Average	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]	Average	Relative variation[2]
Cimarron:																	
Anadarko, Okla.:				*Pounds*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1952..........	11-11-52	1-30-53	97	152,789	1,575	1.58	112	1.38	64	2.97	77	5.48	49	5.46	8	2.49	83
1953..........	8-31-53	12-31-53	1,232	2,070,290	1,680	.45	160	.92	114	1.37	111	3.16	43	6.22	11	1.73	98
Hereford, Texas:																	
1952..........	10-22-52	2-13-53	56	381,585	6,814	2.89	131	1.68	96	4.58	95	7.00	68	3.86	55	4.82	98
1953..........	No dates given		77	237,986	3,091	.79	76	.27	52	1.06	62	2.74	43	5.18	13	.66	61
Van Buren, Ark.:																	
1952..........	11-1-52	1-16-53	60	199,677	3,328	.23	113	1.84	59	2.07	56	3.01	39	5.37	23	1.59	86
1953..........	10-22-53	1-6-54	21	42,175	2,008	.35	57	1.98	30	2.33	30	3.40	33	5.55	10	1.19	51
Baker 1:																	
Carrizo Springs, Tex.:																	
1952..........	8-22-52	1-28-53	27	134,305	4,974	.93	127	1.88	79	2.80	82	3.71	40	5.36	14	2.36	88
1953..........	7-8-53	12-2-53	26	214,665	8,256	.70	120	1.46	106	2.16	91	3.69	44	5.73	16	2.21	89
Muleshoe, Texas:																	
1952..........	10-14-52	12-9-52	59	371,079	6,289	1.93	56	.57	65	2.50	49	1.50	43	4.63	16	1.22	61
1953..........	10-8-53	12-10-53	144	1,994,774	13,852	1.75	122	1.38	83	3.13	80	3.58	47	4.76	12	2.70	82
U. S. 74:																	
Anadarko, Okla.:																	
1952..........	8-30-52	1-30-53	121	112,615	931	.88	116	1.03	77	1.91	64	3.42	46	5.32	11	1.29	81
1953..........	8-27-53	12-30-53	660	740,266	1,122	.43	130	1.08	85	1.51	75	3.57	128	5.62	14	1.30	77
Henryetta, Okla.:																	
1952..........	8-19-52	11-19-52	62	61,197	987	1.52	167	1.06	56	2.59	107	3.11	31	5.76	9	2.79	121
1953..........	8-26-53	11-30-53	145	166,528	1,148	.44	64	.87	78	1.30	52	2.27	36	5.86	9	.90	61
Hugo, Okla.:																	
1952..........	8-18-52	1-31-53	214	347,373	1,623	.49	96	1.02	61	1.51	54	3.09	47	5.81	15	1.09	84
1953..........	8-26-53	11-30-53	145	166,528	1,148	.32	103	.92	67	1.24	60	2.90	36	6.10	13	1.14	72

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[1] Gross pounds delivered before grading deduction.
[2] Coefficient of variation.

TABLE 22.--Grade factors of farmers' lots of castorbeans, by variety and hulling center, 1954 crop

Variety and hulling center	Lots	Gross weight of lots	Marketing period		Foreign material			Cracked and broken beans	Moisture	Grading deduction
			From	To	Free	Attached	Total			
Cimarron:										
Oklahoma:	*Number*	*Pounds*			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Anadarko	389	953	9-4	1-31	.77	.65	1.42	5.44	5.49	1.67
Cheyenne	251	1,122	10-11	2-16	1.40	1.20	2.60	4.35	5.57	2.76
Rush Springs	10	910	9-25	1-29	.17	.80	.97	4.90	5.14	1.21
Erick	277	1,244	8-31	1-28	1.15	.97	2.12	4.74	5.30	2.35
Holdenville	64	825	9-21	11-23	1.52	.71	2.22	2.36	5.85	2.48
Total or average	991	1,069	8-31	2-16	1.08	.89	1.97	4.77	5.48	2.18
Texas:										
Ballinger	44	1,134	9-10	2-14	0.68	0.76	1.44	5.66	5.10	1.71
Bonham	2	173	10-16	12-18	.25	1.40	1.65	7.00	5.35	2.05
Cameron	43	1,076	9-8	2-24	.79	1.12	1.91	5.17	5.95	2.39
Canton	98	967	9-17	1-28	.13	1.26	1.39	2.88	5.31	1.41
Colorado City	107	2,574	11-29	2-15	.49	1.37	1.86	4.98	5.52	2.24
Plainview	37	8,561	11-3	11-27	1.23	1.08	2.31	3.29	4.92	2.34
Stephenville	14	901	9-18	1-22	.60	1.62	2.22	7.20	3.83	2.63
Sulphur Springs	28	902	9-11	1-29	.08	1.39	1.47	3.11	5.24	1.48
Vernon	63	1,521	9-14	2-24	1.82	.86	2.68	3.60	5.39	2.84
Hillsboro	3	527	9-17	2-12	.10	2.00	2.10	5.10	5.37	2.30
Muleshoe	12	13,217	10-21	12-20	2.32	1.02	3.33	5.45	3.81	3.58
Total or average	451	2,389	9-8	2-24	.73	1.17	1.90	4.25	5.29	2.11
New Mexico:										
Carlsbad	19	4,331	11-16	11-25	.33	.82	1.14	4.07	5.07	1.26
Roswell	103	2,977	11-29	12-24	.70	1.41	2.11	5.32	4.80	2.34
Las Cruces	4	917	12-28	1-28	.55	.38	.92	3.15	4.88	.92
Lesbia	168	2,182	11-17	12-20	2.68	1.56	4.25	6.50	5.07	4.60
Loving	28	5,214	11-28	1-14	.67	.66	1.33	4.40	4.77	1.48
Total or average	322	2,914	11-16	1-14	1.71	1.37	3.08	5.75	4.96	3.36
Missouri:										
Holcomb	363	1,402	11-2	1-29	0.59	2.43	3.02	6.42	7.97	5.35
Arkansas:										
Corning	98	1,153	11-12	2-11	2.14	1.38	3.52	5.42	6.28	4.19
Earle	62	4,049	11-29	3-15	1.07	1.35	2.41	5.94	6.38	3.27
Lewisville	21	1,483	9-28	11-1	.25	.70	.96	4.81	5.39	1.16
Total or average	181	2,183	9-28	3-15	1.55	1.29	2.84	5.53	6.21	3.52
United States	2,308	1,724	8-31	3-15	1.06	1.28	2.34	5.12	5.82	2.94
Conner:										
Oklahoma:										
Anadarko	135	722	9-4	1-31	.92	1.08	1.99	7.74	5.53	2.53
Cheyenne	6	1,083	11-16	12-14	1.50	.77	2.27	5.38	5.55	2.52
Rush Springs	123	737	9-17	2-26	.41	1.16	1.57	6.39	5.26	1.91
Total or average	264	737	9-4	2-26	.69	1.11	1.80	7.06	5.41	2.24
Texas:										
Bonham	39	477	9-18	1-8	.32	1.31	1.62	9.99	5.83	2.57
Cameron	5	989	9-8	12-17	.60	.80	1.40	5.46	5.86	1.66
Canton	9	891	10-8	1-28	.13	1.36	1.49	3.62	5.61	1.59
Clarksville	34	994	9-1	1-5	.12	.79	.91	2.86	6.12	1.39
Elkhart	64	996	9-7	1-27	.61	1.45	2.06	5.93	5.66	2.64
Stephenville	54	502	9-11	1-22	.84	1.38	2.22	9.70	4.22	2.90
Sulphur Springs	150	695	9-11	1-29	.13	1.08	1.21	4.12	5.18	1.31
Vernon	21	1,488	9-28	1-28	1.42	.73	2.15	4.94	5.48	2.40
Hillsboro	37	515	9-4	2-12	.16	1.49	1.65	6.51	5.66	2.11
Total or average	413	752	9-1	2-12	.39	1.20	1.58	5.85	5.34	1.99
United States	677	746	9-1	2-26	.51	1.16	1.67	6.32	5.37	2.09
Mixed:										
Oklahoma:										
Anadarko	5	774	9-20	12-21	0.40	1.32	1.72	5.10	5.16	1.92
Erick	51	1,097	11-11	1-31	1.65	1.05	2.69	3.86	5.31	2.80
Total or average	56	1,068	9-20	1-31	1.53	1.07	2.61	3.98	5.30	2.72
Texas:										
Plainview	5	1,316	12-14	12-16	0.32	1.24	1.56	1.78	4.62	1.56
Vernon	11	2,417	9-14	3-11	1.97	.96	2.94	2.62	5.22	2.96
Total or average	16	2,073	9-14	3-11	1.46	1.05	2.51	2.36	5.03	2.52
United States	72	1,292	9-14	3-11	1.52	1.07	2.58	3.62	5.24	2.68
Hybrid 4:										
Oklahoma:										
Anadarko	13	1,333	9-7	1-4	0.94	0.95	1.88	4.28	5.64	2.05
California:										
Bakersfield	70	11,282	10-2	1-18	2.30	2.62	4.92	10.77	6.27	6.23
Tulare	148	14,632	9-29	2-28	2.42	2.46	4.87	9.64	6.34	6.13
Total or average	218	13,556	9-29	2-28	2.38	2.51	4.89	10.00	6.32	6.16

Continued-

TABLE 22.—Grade factors of farmers' lots of castorbeans, by variety and hulling center, 1954 crop—Continued

Variety and hulling center	Lots	Gross weight of lots	Marketing period		Foreign material			Cracked and broken beans	Moisture	Grading deduction
			From	To	Free	Attached	Total			
Hybrid 4—Continued										
New Mexico:	*Number*	*Pounds*			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Carlsbad	4	2,890	11-19	11-25	.55	.48	1.02	3.32	5.00	1.08
Roswell	43	3,212	11-18	12-17	.55	1.47	2.02	4.78	4.76	2.20
Hatch	41	9,127	11-29	12-24	.78	.54	1.32	4.06	4.41	1.42
Las Cruces	30	14,019	12-1	1-28	.52	.36	.88	3.71	4.88	.96
Total or average	118	8,004	11-18	1-28	0.62	0.83	1.45	4.21	4.68	1.58
Arizona:										
Phoenix	12	11,407	10-14	10-22	3.66	5.90	9.56	10.58	4.44	10.30
Yuma	8	7,370	9-29	2-28	1.71	.40	2.10	9.89	4.96	2.79
Total or average	20	9,792	9-29	2-28	2.88	3.70	6.58	10.30	4.65	7.30
United States	369	11,146	9-7	2-28	1.80	1.98	3.78	7.96	5.68	4.61
U. S. 74:										
Oklahoma:										
Anadarko	30	812	11-17	1-31	0.60	1.21	1.81	4.07	5.29	1.93
Rush Springs	18	701	10-5	12-14	.21	.97	1.17	4.32	5.24	1.31
Holdenville	19	686	9-21	11-26	1.02	.65	1.66	2.48	5.52	1.84
Erick	25	1,068	10-2	1-19	.91	.93	1.84	2.75	5.49	2.11
Total or average	92	834	9-21	1-31	0.69	0.97	1.66	3.43	5.38	1.84
Texas:										
Vernon	2	2,611	9-21	10-8	0.65	1.20	1.85	3.85	5.60	2.05
United States	94	872	9-21	1-31	.69	.98	1.67	3.44	5.39	1.84
Hybrid 10:										
Texas:										
Dell City	2	8,685	12-1	12-1	0.90	.65	1.55	7.60	4.10	2.00
Cimarron and Conner Mixed:										
Texas:										
Elkhart	12	810	9-7	2-4	0.31	1.67	1.98	5.82	5.26	2.28
Baker 195:										
Texas:										
Plainview	5	1,968	11-8	11-18	.66	.30	.96	1.04	5.00	.96
Arizona:										
Phoenix	65	7,916	10-25	2-15	5.46	1.50	6.96	9.53	5.52	7.88
United States	70	7,491	10-25	2-15	5.11	1.42	6.53	8.92	5.49	7.39
Baker:										
Texas:										
Muleshoe	35	14,090	9-9	3-30	1.07	1.50	2.57	3.23	4.33	2.63
Hybrid 7:										
New Mexico:										
Carlsbad	14	6,794	11-16	11-25	.34	.56	.90	2.92	4.77	.91
Hatch	2	8,522	12-8	12-23	.60	.60	1.20	4.60	4.40	1.35
Lemitar	38	8,189	11-5	12-13	1.22	1.26	2.48	6.13	4.49	2.80
Loving	34	6,141	11-28	1-14	.62	.47	1.09	3.66	4.76	1.18
Total or average	88	7,184	11-5	1-14	.84	.83	1.66	4.63	4.64	1.84
Hybrid:										
New Mexico:										
Roswell	32	3,050	12-18	1-22	.52	.75	1.28	3.08	4.89	1.28
Cimarron and Hybrid Mixed:										
Texas:										
Plainview	18	8,153	11-1	11-24	.98	.96	1.94	3.21	4.86	1.98
United States, all varieties	3,777	2,831	8-31	3-15	1.09	1.31	2.40	5.56	5.64	2.95

TABLE 23.--Grade factors of farmers' lots of castorbeans, dryland or irrigated, by variety and hulling center, 1953 crop

Variety and hulling center	Marketing period		Lots	Gross weight of lots	Foreign material			Cracked and broken beans	Moisture	Grading deduction
	From	To			Free	Attached	Total			
Conner:										
Dryland:										
Oklahoma:			*Number*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Anadarko	8-27	12-30	1,332	1,129	0.27	1.20	1.47	4.23	6.04	1.90
Henryetta	8-26	1-9	403	1,054	.62	1.12	1.74	3.81	5.67	2.04
Holdenville	9-10	1-7	194	935	1.75	.55	2.30	3.53	6.17	2.78
Hugo	8-26	9-18	69	912	.40	1.45	1.85	2.60	5.98	2.16
Ripley	8-24	1-30	239	1,078	.43	.97	1.40	3.92	5.80	1.72
Rush Springs	8-25	1-27	1,511	989	.31	1.02	1.33	4.66	5.75	1.65
Total or average	8-25	1-30	3,748	1,048	.41	1.08	1.49	4.27	5.87	1.85
Texas:										
Atlanta	8-10	12-18	572	872	.26	.49	.75	4.52	6.09	1.23
Brownwood	8-13	1-23	246	885	1.14	1.23	2.37	4.25	5.44	2.59
Elkhart	8-13	1-8	1,674	1,051	.32	1.03	1.35	3.54	5.22	1.50
Floresville	7-8	1-22	124	683	.41	.76	1.17	4.40	6.14	1.58
Giddings	7-20	1-29	541	916	.11	1.13	1.24	5.10	5.90	1.79
Stephenville	8-12	1-29	1,184	892	.96	1.39	2.34	5.36	5.15	2.68
Total or average	8-10	1-29	4,341	947	.51	1.07	1.58	4.42	5.47	1.89
Irrigated:										
Texas:										
Muleshoe	11-30	1-5	35	7,486	2.00	1.75	3.76	5.08	4.42	4.29
Dryland and irrigated:										
United States	8-10	1-29	8,124	1,022	.47	1.08	1.55	4.36	5.65	1.88
Cimarron:										
Dryland:										
Arkansas:										
Lewisville	9-22	1-20	127	1,395	.35	.58	.93	3.02	5.89	1.18
Stuttgart	9-21	3-5	71	1,956	.41	.77	1.18	2.73	6.41	1.77
Van Buren	10-22	1-6	21	2,008	.35	1.98	2.33	3.40	5.55	2.50
Total or average	10-22	3-5	219	1,636	.37	.77	1.15	2.96	6.03	1.50
Oklahoma:										
Anadarko	8-31	12-31	1,232	1,680	.45	.92	1.37	3.16	6.22	1.77
Holdenville	9-8	12-17	99	1,147	1.11	.54	1.65	2.17	6.06	1.86
Hugo	12-16	1-6	9	3,214	.51	1.38	1.89	5.38	5.87	2.46
Ripley	10-9	11-6	19	1,565	.46	.84	1.30	3.65	5.83	1.47
Rush Springs	9-10	12-11	45	1,308	.30	.87	1.17	3.25	5.83	1.48
Total or average	8-31	1-6	1,404	1,639	.49	.90	1.39	3.11	6.19	1.76
Texas:										
Edinburg	8-12	1-29	6	3,296	.70	1.35	2.05	9.52	6.77	3.47
Elkhart	8-18	12-22	63	975	.28	.81	1.09	1.88	4.75	1.10
Giddings	8-4	3-1	126	888	.11	1.18	1.29	4.25	6.19	1.84
Stephenville	8-18	1-11	19	816	.54	1.61	2.15	4.74	4.81	2.33
Total or average	8-12	1-11	214	975	.22	1.11	1.33	3.75	5.66	1.71
Irrigated:										
Texas:										
Crystal City	7-20	1-8	12	2,911	.60	1.32	1.92	3.03	4.58	2.08
Floydada	10-10	1-12	47	23,263	1.20	1.21	2.41	3.70	5.29	2.54
Ft. Stockton	12-7	1-4	23	3,171	1.15	1.56	2.71	3.98	5.26	2.81
Hereford	—	—	77	3,091	.79	.27	1.06	2.74	5.18	1.09
Muleshoe	11-11	12-10	20	12,373	2.41	1.69	4.10	4.78	4.72	4.90
Total or average	7-20	1-18	179	9,423	1.11	.91	2.02	3.40	5.13	2.18
New Mexico:										
Tucumcari	10-31	12-23	47	2,605	1.01	1.83	2.84	4.87	5.65	3.06
United States	7-20	3-5	2,063	2,267	.52	.93	1.44	3.23	6.01	1.80
U. S. 74:										
Dryland:										
Oklahoma:										
Anadarko	8-27	12-30	660	1,122	.43	1.08	1.51	3.57	5.62	1.68
Henryetta	8-26	11-30	145	1,148	.44	.87	1.31	2.27	5.86	1.48
Holdenville	9-9	1-7	313	1,122	1.02	1.16	2.18	1.86	5.90	2.35
Hugo	9-18	1-8	152	1,097	.32	.92	1.24	2.90	6.10	1.58
Ripley	9-11	12-30	353	1,134	.45	.92	1.37	3.24	5.63	1.43
Rush Springs	8-26	1-27	304	912	.22	1.10	1.32	2.59	5.41	1.39
Total or average	8-27	1-8	1,927	1,091	.49	1.04	1.52	2.92	5.69	1.68
Texas:										
Elkhart	8-13	11-27	65	1,027	.28	1.49	1.77	1.63	5.41	1.93
Giddings	7-20	1-22	34	639	.07	1.54	1.61	2.91	5.89	1.82
Stephenville	9-18	11-25	4	912	.43	1.78	2.21	2.73	5.13	2.23
Total or average	8-13	11-27	103	895	.22	1.52	1.73	2.10	5.56	1.91
Irrigated:										
New Mexico:										
Tucumcari	10-23	12-19	270	3,853	.91	1.63	2.54	4.96	5.59	2.78
Dryland and irrigated:										
United States	8-13	1-22	2,300	1,406	.52	1.13	1.65	3.13	5.67	1.82

Continued-

TABLE 23.--Grade factors of farmers' lots of castorbeans, dryland or irrigated, by variety and hulling center, 1953 crop.--Continued

Variety and hulling center	Marketing period		Lots	Gross weight of lots	Foreign material			Cracked and broken beans	Moisture	Grading deduction
	From	To			Free	Attached	Total			
Hybrid 4:										
Dryland:										
Texas:			*Number*	*Pounds*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Giddings....................	8-21	9-8	6	598	.17	.50	.67	4.05	6.70	1.43
Irrigated:										
New Mexico:										
Tucumcari....................	10-30	12-16	17	3,263	.76	2.28	3.04	7.18	5.60	3.52
Dryland and irrigated:										
United States..................	8-21	12-16	23	2,568	.61	1.82	2.43	6.36	5.89	2.97
Baker 1:										
Irrigated:										
Texas:										
Carrizo Springs..............	7-8	12-2	26	8,256	.70	1.46	2.16	3.69	5.73	2.49
Crystal City.................	6-30	1-21	71	5,763	.71	1.53	2.24	2.26	5.48	2.26
Muleshoe.....................	10-8	12-10	144	13,853	1.75	1.38	3.13	3.58	4.76	3.30
United States..................	6-30	1-21	241	10,866	1.33	1.43	2.76	3.20	5.08	2.91

TABLE 24.--Grade factors of farmers' lots of castorbeans, by variety and hulling center, 1952 crop

Variety and hulling center	Lots	Gross weight of lots	Marketing period		Foreign material			Cracked and broken beans	Moisture	Grading deduction
			From	To	Free	Attached	Total			
Conner:										
Oklahoma:	*Number*	*Pounds*			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Anadarko........................	1,131	909	8-19	1-30	.51	1.45	1.96	5.21	5.36	1.97
Ardmore.........................	95	1,173	9-2	2-9	1.04	1.75	2.79	5.09	5.15	2.73
Chickasha.......................	697	854	9-13	12-19	.51	1.76	2.27	5.14	5.15	2.22
Erick...........................	8	1,284	11-1	1-29	.29	.68	.96	3.80	4.83	.78
Henryetta.......................	354	861	8-28	12-11	2.02	2.23	4.25	5.05	5.80	4.26
Ripley..........................	404	933	8-29	1-15	.62	1.57	2.19	5.10	5.31	2.21
Rush Springs....................	244	1,054	8-26	9-22	.26	1.58	1.84	5.79	5.27	1.94
Total or average............	2,933	915	8-19	2-9	.70	1.65	2.36	5.20	5.33	2.36
Texas:										
Atlanta.........................	331	814	9-2	12-30	0.37	0.64	1.01	4.13	5.86	0.97
Ballinger.......................	21	352	10-13	1-27	1.12	1.20	2.32	6.56	5.26	2.65
Bonham..........................	338	775	9-9	1-31	.17	.93	1.10	4.57	5.43	1.03
Brownwood.......................	150	594	8-18	1-30	.92	1.76	2.68	5.37	5.29	2.73
Carbon..........................	425	616	8-27	1-31	.34	.80	1.14	4.10	5.89	1.07
Chico...........................	129	668	9-15	1-7	.59	1.03	1.62	3.12	5.34	1.30
Chillicothe.....................	8	979	9-3	1-5	1.21	1.06	2.27	4.85	5.53	2.15
Clarksville.....................	95	835	9-2	1-14	.14	.61	.75	2.85	5.67	.58
Cross Plains....................	295	533	8-22	1-31	.30	.77	1.07	3.39	5.54	.82
Devine..........................	308	1,263	7-30	1-30	.91	2.16	3.07	6.29	5.62	3.38
Edinburg........................	23	2,155	8-21	10-9	1.36	.34	1.70	3.40	5.86	1.54
Elkhart.........................	1,187	852	8-12	1-20	.57	1.11	1.68	4.58	5.91	1.75
Floresville.....................	804	830	7-28	1-31	.59	1.61	2.20	5.40	6.10	2.48
Giddings........................	583	609	7-30	1-26	.22	1.52	1.74	5.39	5.85	1.91
Gilmer..........................	164	684	9-2	1-20	.26	.91	1.17	4.01	5.55	.97
Grand Saline....................	275	876	9-2	12-26	.48	.84	1.32	4.13	5.60	1.17
Hallettsville...................	46	706	9-23	1-30	.17	.81	.98	4.74	6.09	1.18
Hillsboro.......................	787	814	8-12	1-30	.19	1.17	1.36	4.59	5.47	1.31
Jewett..........................	165	1,165	8-19	1-30	.30	1.37	1.67	4.77	5.65	1.66
Jourdanton......................	236	1,184	7-31	10-22	.49	1.78	2.27	6.49	5.71	2.55
Keller..........................	112	796	9-5	1-8	.26	.99	1.25	5.10	5.49	1.28
Llano...........................	160	1,043	8-26	1-31	.27	1.35	1.62	5.52	5.52	1.73
Malakoff........................	162	678	9-6	12-23	.33	.72	1.05	3.80	5.55	.90
Mt. Pleasant....................	118	689	9-24	1-8	.08	.73	.81	4.66	5.42	.81
Nixon...........................	128	1,225	8-6	1-22	.66	1.82	2.48	3.58	6.06	2.44
Pontotoc........................	273	798	8-25	1-21	.61	1.28	1.89	6.70	5.68	2.30
San Antonio.....................	557	1,105	7-25	1-31	.39	1.91	2.30	5.42	5.99	2.50
San Benito......................	41	2,109	9-5	10-22	.59	.55	1.14	5.39	6.42	1.66
Smithville......................	106	922	8-13	1-15	.14	.95	1.09	4.77	5.80	1.15
Stephenville....................	995	565	8-15	1-31	.54	1.08	1.62	3.47	5.37	1.30
Sulphur Springs.................	764	812	9-3	1-31	.04	.83	.87	4.74	5.58	.89
Tatum...........................	273	1,015	8-27	12-22	.20	1.07	1.27	4.28	5.80	1.28
Vernon..........................	20	779	9-23	1-5	.76	.86	1.62	4.93	5.08	1.46
Waller..........................	354	1,420	8-19	1-26	.85	1.52	2.37	4.42	5.55	2.32
Weatherford.....................	225	523	8-27	1-31	.18	1.33	1.51	5.02	5.52	1.51
Wellington......................	7	992	9-22	12-26	.10	.49	.59	2.37	4.90	.14
Whitesboro......................	661	638	8-26	1-31	.44	1.36	1.80	5.08	5.42	1.83
Total or average............	11,326	824	7-25	1-31	.41	1.22	1.63	4.70	5.68	1.65
United States....................	14,259	843	7-25	2-9	.47	1.31	1.78	4.80	5.60	1.79
Baker 1:										
Oklahoma:										
Altus...........................	2	2,595	9-3	10-6	1.55	1.10	2.65	3.60	4.80	2.30

Continued-

TABLE 24.--Grade factors of farmers' lots of castorbeans, by variety and hulling center, 1952 crop.--Continued

Variety and hulling center	Lots	Gross weight of lots	Marketing period		Foreign material			Cracked and broken beans	Moisture	Grading deduction
			From	To	Free	Attached	Total			
Baker 1—Continued										
Texas:	*Number*	*Pounds*			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Carrizo Springs	27	4,974	8-22	1-28	.93	1.88	2.81	3.71	5.36	2.67
Eagle Pass	28	4,951	9-11	1-22	.54	.54	1.08	3.46	5.43	.77
Edinburg	78	2,595	8-1	1-29	1.38	.66	2.04	4.53	5.81	2.02
Floydada	81	5,670	10-10	11-14	.77	1.34	2.11	3.88	4.50	1.87
Friona	74	6,090	10-7	12-16	1.41	1.04	2.45	1.56	4.78	1.98
Ft. Stockton	68	2,425	10-14	1-15	1.63	.56	2.19	2.19	4.81	1.72
Hale Center	126	7,040	10-7	11-22	2.66	1.00	3.66	3.17	4.81	3.32
Laredo	4	10,075	10-22	10-28	.43	.42	.85	1.68	5.48	.38
Lehman	43	7,019	10-18	11-18	1.36	1.56	2.92	2.27	5.07	2.46
Muleshoe	59	6,289	10-14	12-9	1.93	.57	2.50	1.50	4.63	2.00
New Deal	69	4,092	10-16	11-22	1.28	1.27	2.55	2.15	5.03	2.07
Ralls	108	4,882	10-11	12-13	1.27	.70	1.97	3.69	4.98	1.72
San Angelo	70	3,156	10-2	1-14	1.04	.64	1.68	3.67	5.85	1.45
San Benito	9	578	11-3	1-10	.11	.83	.94	5.43	6.52	1.60
Seagraves	101	4,334	10-4	1-31	1.62	.93	2.55	2.86	5.30	2.17
Total or average	945	4,893	8-1	1-31	1.48	.93	2.41	3.03	5.08	2.09
United States	947	4,888	8-1	1-31	1.48	.93	2.41	3.03	5.08	2.09
Baker 7:										
Texas:										
Hereford	7	7,707	10-22	12-6	2.40	1.07	3.47	5.13	5.06	3.43
Cimarron:										
Arkansas:										
Van Buren	60	3,328	11-1	1-16	.23	1.84	2.07	3.01	5.37	1.84
Oklahoma:										
Altus	30	2,313	8-27	1-29	.58	1.03	1.61	5.34	4.96	1.59
Anadarko	97	1,575	10-31	1-30	1.58	1.38	2.96	5.48	5.46	3.01
Erick	19	1,015	10-29	1-29	.36	1.01	1.37	2.79	4.77	.96
McAlester	9	1,439	10-11	11-14	1.84	.67	2.51	2.87	5.41	2.06
Total or average	155	1,641	8-27	1-30	1.26	1.23	2.49	4.97	5.34	2.43
Texas:										
Chillicothe	4	583	11-10	12-15	.55	.93	1.48	5.30	5.13	1.43
Hereford	56	6,814	10-22	2-13	2.89	1.68	4.57	7.00	5.02	4.94
Vernon	29	987	9-23	2-12	.71	.87	1.58	3.75	5.19	1.28
Wellington	5	779	10-30	12-26	.14	.62	.76	2.56	4.77	.26
Total or average	94	4,430	9-23	2-13	1.97	1.34	3.31	5.69	5.08	3.42
United States	309	2,817	8-27	2-13	1.27	1.38	2.65	4.81	5.28	2.62
U. S. 74:										
Oklahoma:										
Altus	14	1,492	9-10	1-6	.41	.84	1.25	2.81	5.23	.83
Anadarko	121	931	8-30	1-30	.88	1.03	1.91	3.42	5.36	1.60
Erick	4	1,723	11-1	12-19	.83	1.28	2.11	3.58	4.77	1.88
Henryetta	62	987	8-19	11-19	1.52	1.06	2.58	3.11	5.76	2.31
Hugo	214	1,623	8-18	1-30	.49	1.02	1.51	3.09	5.89	1.30
McAlester	6	2,532	9-27	11-14	1.50	.65	2.15	1.97	5.22	1.75
Total or average	421	1,340	8-18	1-30	.77	1.02	1.79	3.17	5.68	1.53
Texas:										
Chillicothe	7	1,227	9-1	1-5	.99	1.20	2.19	3.21	5.50	1.79
Vernon	16	1,278	9-2	1-5	1.43	.87	2.30	3.11	5.01	1.91
Total or average	23	1,263	9-1	1-5	1.29	.97	2.26	3.14	5.16	1.87
United States	444	1,336	8-18	1-30	.80	1.02	1.81	3.17	5.65	1.55

TABLE 25.--Production of castorbeans, by State, 1951-54 crops

State	Harvested acreage				Production							
					Total				Per acre			
	1951	1952	1953	1954	1951	1952	1953	1954	1951	1952	1953	1954
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Texas[1]	19.5	72.2	79.6	10.0	2.6	17.5	30.2	2.4	135	342	380	243
Oklahoma[1]	24.3	23.6	35.5	7.4	3.3	4.9	10.6	1.4	137	208	299	186
California (irrigated)	15.1	1.3	3.7	2.3	11.4	1.6	5.4	2.9	756	1,218	1,442	1,275
Arizona (irrigated)	3.8	.5	2.6	.7	3.4	.4	3.5	.6	905	982	1,354	912
Arkansas[1]	(2)	(4)	1.3	1.0	(3)	.1	.4	.3	430	(4)	288	307
New Mexico (irrigated)	—	—	1.8	3.7	—	—	1.2	2.6	—	—	665	700
Missouri[1]	—	—	—	1.5	—	—	—	.5	—	—	—	323
Total or average	62.7	97.6	124.5	26.6	20.8	24.6	51.3	10.7	332	252	412	488

[1] Mostly dryland.
[2] Less than 50 acres.
[3] About 15,000 pounds.
[4] Not available.

TABLE 26.--Acreage and yield of castorbeans, United States, 1951-54 crops[1]

Item	Unit	1951	1952	1953	1954
Acreage:					
Planted..........	Acres	83,659	120,099	149,182	35,033
Harvested........	do.	62,735	97,576	124,546	26,565
Percentage of planted acreage harvested........	Percent	75.0	81	83	76
Production.........	Pound	20,849,011	24,570,106	51,343,539	10,739,357
Yield per acre...	do.	332	252	412	488
Oil[2]............	do.	8,440,545	12,000,000	23,000,000	4,500,000

[1] In 1951 and 1952, there was a drought in Texas and Oklahoma, coupled with an early killing frost. In 1953 the drought conditions continued throughout the growing season with increased moisture during the harvest period.

[2] Oil outturn at processing plants as estimated by Commodity Credit Corporation.

TABLE 27.--Average weight per bushel of castorbeans, dryland and irrigated, by State, 1951-54 crops

Crop year and State	Dryland				Irrigated			
	Farmers' stock basis		Clean basis		Farmers' stock basis		Clean basis	
1951	*Lb.*	*Oz.*	*Lb.*	*Oz.*	*Lb.*	*Oz.*	*Lb.*	*Oz.*
Oklahoma.........	--	--	38	15	--	--	--	--
Texas............	--	--	41	9	--	--	--	--
All States.....	--	--	40	5	--	--	--	--
1952								
Oklahoma.........	--	--	40	1	--	--	39	0
Texas............	--	--	40	7	--	--	41	7
All States.....	--	--	40	6	--	--	41	3
1953								
Oklahoma.........	38	6	39	11	--	--	--	--
Texas............	38	5	39	6	39	12	40	9
Arkansas.........	39	14	41	6	--	--	--	--
New Mexico.......	--	--	--	--	40	7	41	9
All States.....	38	6	39	8	39	14	40	12
1954								
Arkansas.........	38	5	39	6	--	--	--	--
Missouri.........	39	3	40	2	--	--	--	--
New Mexico.......	38	11	40	13	39	2	40	8
Oklahoma.........	39	1	40	2	--	--	--	--
Texas............	38	12	39	13	39	4	40	5
All States.....	38	13	39	14	39	2	40	7
Average, 1951-54...	38	8	39	14	39	11	40	13

Farmers' stock basis includes free foreign material and beans with hulls attached.

TABLE 28.--Average weight per bushel of castorbeans, dryland and irrigated, by variety, 1951-54 crops

Crop year and variety	Dryland				Irrigated			
	Farmers' stock basis		Clean basis		Farmers' stock basis		Clean basis	
1951:	*Lb.*	*Oz.*	*Lb.*	*Oz.*	*Lb.*	*Oz.*	*Lb.*	*Oz.*
Baker 7..................	--	--	43	6	--	--	--	--
Cimarron.................	--	--	40	12	--	--	--	--
Conner...................	--	--	40	7	--	--	--	--
U. S. 74.................	--	--	38	10	--	--	--	--
All varieties..........	--	--	40	5	--	--	--	--
1952:								
Baker 1..................	--	--	--	--	--	--	41	4
Cimarron.................	--	--	39	12	--	--	40	14
Conner...................	--	--	40	5	--	--	--	--
U. S. 74.................	--	--	39	14	--	--	--	--
All varieties..........	--	--	40	6	--	--	41	3
1953:								
Baker 1..................	--	--	--	--	40	0	40	8
Baker 195................	--	--	--	--	43	0	44	0
Cimarron.................	40	3	41	6	39	14	40	14
Conner...................	38	2	39	3	--	--	--	--
Hybrid...................	37	8	38	8	--	--	--	--
Hybrid 4.................	39	0	40	0	37	10	38	13
U. S. 74.................	37	5	38	6	40	0	41	3
All varieties..........	38	6	39	8	39	14	40	12
1954:								
Baker....................	--	--	--	--	38	8	39	13
Cimarron.................	39	0	40	0	38	13	40	14
Cimarron-Hybrid..........	--	--	--	--	40	0	40	13
Conner...................	38	11	39	13	--	--	--	--
Hybrid 4.................	--	--	--	--	39	13	40	5
Hybrid 7.................	38	11	40	13	39	0	39	13
U. S. 74.................	37	13	38	13	--	--	--	--
All varieties..........	38	13	39	14	39	2	40	7
Average, 1951-54..........	38	8	39	14	39	11	40	13

Farmers' stock includes free foreign material and beans with hulls attached.

TABLE 29.--Acreage, production, and yield of castorbeans under irrigation in the southern plains of Texas, by county, 1952 crop

Variety and county	Contracts	Acreage harvested	Gross weight	Grading deduction	Net weight	Net weight per acre	Bushels per acre[1]
Baker 1:	*Number*	*Acres*	*Pounds*	*Percent*	*Pounds*	*Pounds*	*Number*
Bailey...	19	352.0	309,410	2.2	302,464	859	21.0
Lubbock..	12	302.2	254,210	2.0	249,261	825	20.1
Hale.....	31	946.7	814,180	3.5	785,768	830	20.2
Floyd....	23	698.5	434,990	1.8	427,024	611	14.9
Total..	85	2,299.4	1,812,790	2.7	1,764,517	767	18.7
Baker 195:							
Bailey...	4	56.6	42,820	1.4	42,207	746	18.2
Lubbock..	3	30.7	30,030	2.4	29,308	955	23.3
Hale.....	5	88.2	79,500	2.0	76,917	872	21.3
Floyd....	3	29.7	24,390	.5	24,262	815	19.9
Total..	15	205.2	175,740	1.7	172,694	841	20.5
State......	100	2,504.6	1,988,530	2.6	1,937,211	773	18.9

[1] Computed on the basis of 41 pounds per bushel.

TABLE 30.--Castor oil mill operations, U. S. by month through 3 operating seasons, August 1951 through July 1954

Year and month	Castorbeans			Castorbean products[2]						
	Received	Crushed	Stocks end of month	Crude oil No. 1		Crude oil No. 3		Total oil outturn per ton[1]	Pomace	
				Production	Outturn per ton	Production	Outturn per ton		Production	Outturn per ton
	Tons	*Tons*	*Tons*	*1,000 pounds*	*Pounds*	*1,000 pounds*	*Pounds*	*Pounds*	*Tons*	*Pounds*
1951-52:										
August	3,371	6,314	4,055	4,395	696	1,455	230	926	3,434	1,088
September	1,887	4,437	1,505	3,199	721	982	221	942	2,340	1,055
October	3,638	4,275	868	3,111	728	948	222	950	2,274	1,064
November	4,360	2,084	3,144	1,448	695	485	233	928	1,127	1,082
December	9,422	5,756	6,810	3,792	659	1,550	269	928	3,031	1,053
January	10,789	7,009	10,590	4,881	696	1,663	237	933	3,726	1,063
February	8,733	6,843	12,480	4,269	624	2,014	294	918	3,712	1,085
March	5,759	7,145	11,094	4,970	696	1,629	228	924	3,795	1,062
April	5,520	7,216	9,398	4,779	662	1,791	248	910	3,840	1,064
May	6,261	6,893	8,766	4,686	680	1,630	236	916	4,007	1,163
June	3,642	6,462	5,946	4,755	736	1,384	214	950	3,315	1,026
July	5,289	5,389	5,846	3,910	726	1,039	193	919	2,870	1,065
Season	68,671	69,823	---	48,195	690	16,570	237	927	37,471	1,073
1952-53:										
August	8,238	9,243	4,841	6,600	714	1,943	210	924	4,951	1,071
September	2,721	6,011	1,551	4,269	710	1,353	225	935	3,267	1,087
October	5,599	5,535	1,615	3,897	704	1,353	244	948	2,901	1,048
November	6,909	4,994	3,530	3,549	711	1,161	232	943	2,584	1,035
December	12,118	6,767	8,881	4,518	668	1,939	287	955	3,519	1,040
January	10,403	7,126	12,158	4,830	678	1,775	249	927	3,817	1,071
February	7,211	6,493	12,876	4,700	724	1,470	226	950	3,426	1,055
March	6,265	7,664	11,477	5,453	712	1,658	216	928	4,123	1,076
April	7,168	7,031	11,614	4,815	685	1,570	223	908	3,925	1,116
May	3,746	5,188	10,172	3,643	702	1,217	235	937	3,076	1,186
June	2,713	5,853	7,032	4,335	741	1,194	204	945	3,036	1,037
July	7,068	5,003	9,097	3,558	711	1,095	219	930	2,738	1,095
Season	80,159	76,908	---	54,167	704	17,728	231	935	41,363	1,076
1953-54:										
August	7,329	5,044	11,382	3,570	708	1,159	230	938	2,667	1,057
September	4,000	4,654	10,728	3,319	713	1,049	225	938	2,478	1,065
October	6,072	5,092	11,708	3,693	725	695	136	861	2,709	1,064
November	8,528	4,864	15,372	3,428	705	1,074	221	926	2,527	1,039
December	9,731	7,556	17,547	5,396	714	1,494	198	912	4,001	1,059
January	10,879	5,526	22,900	3,739	677	1,433	259	936	2,910	1,053
February	3,937	7,213	19,624	3,564	494	3,270	453	947	3,767	1,045
March	117	7,102	12,639	5,095	717	1,669	235	952	3,827	1,078
April	320	8,403	4,556	6,220	740	1,769	211	951	4,460	1,062
May	5,662	6,328	4,157	4,771	754	1,028	162	916	3,447	1,089
June	5,860	4,059	5,958	2,888	712	854	210	922	2,177	1,073
July	4,240	3,086	7,112	2,194	711	636	206	917	1,687	1,093
Season	66,675	68,927	---	47,877	695	16,130	234	929	36,657	1,064

[1] Usually No. 1 oil is extracted by cold-pressing with hydraulic presses. Most No. 3 oil is extracted with a solvent. A minor amount of oil, which may meet specifications for either No. 1 or No. 3 is obtained by screw-pressing.

[2] In some months the total outturn of oil and pomace exceeds a ton. This represents the overestimates made by processors, who based the tons of beans crushed on the oil recovered.

Source: Facts for Industry, Bureau of the Census.

TABLE 31.--CASTORBEANS: Production in specified countries and the world, averages 1935-39 and 1945-49, annual 1950-1954

(Short tons)

Continent and country	Average		1950	1951	1952	1953[1]	1954[1]
	1935-39	1945-49					
NORTH AMERICA							
Mexico	2,770	3,195	2,790	2,850	2,920	3,860	3,860
United States[2]	--	--	--	10,425	12,300	25,675	7,000
Haiti	[3] 700	2,585	3,640	5,080	4,590	[4] 3,745	[5] 2,800
Estimated total[6]	3,705	6,340	7,055	19,110	20,450	34,020	14,330
EUROPE							
Italy	[3] 3,790	2,930	875	700	620	1,210	--
Yugoslavia	490	[3] 1,740	1,490	2,200	390	--	--
Estimated total	4,280	4,670	2,365	2,900	1,010	2,860	1,825
Other Europe, estimated total	2,885	1,955	2,240	3,310	2,240	3,320	2,250
All Europe (excl. U.S.S.R.), estimated total[6]	7,165	6,625	4,605	6,210	3,250	6,180	4,075
U.S.S.R. (Europe and Asia)	117,745	[7] 55,110	--	--	--	--	--
ASIA							
Iran	[8] 180	6,500	8,270	8,270	8,270	8,270	--
Manchuria	[3] 26,600	--	--	--	--	--	--
India[9] [10]	127,456	133,728	143,360	116,480	117,600	118,720	119,840
Indochina	[3] 5,510	[3] 295	--	--	--	--	--
Korea[11]	[3] 1,425	[3] 2,215	1,130	1,300	1,160	1,200	--
Pakistan[9]	--	[3] 300	560	--	--	--	--
Thailand	--	[3] 550	[8] 8,047	[8] 14,127	[8] 19,406	[8] 19,215	--
Estimated total (excl. U.S.S.R.)[6]	170,780	176,135	192,940	172,335	178,545	179,565	180,500
SOUTH AMERICA							
Argentina	8,800	3,265	4,935	2,800	1,100	2,190	5,070
Brazil	147,995	207,180	202,820	195,430	174,240	177,325	199,300
Colombia	[3] 785	[12] 5,130	--	--	--	--	--
Ecuador	[3] [8] 29	2,800	7,100	8,365	10,900	[4] 8,296	[5] 10,500
Paraguay	[3] 3,275	[3] 1,065	1,100	[13] 1,340	[13] 950	[13] 2,760	--
Estimated total[6]	160,885	219,690	220,155	212,135	191,390	194,770	220,070
AFRICA							
Belgian Congo[14]	[3] 8	[3] 2,335	2,200	2,800	3,125	1,255	--
Tanganyika	[3] [8] 9	945	1,985	4,515	8,100	6,870	7,000
Uganda[15]	--	--	1,570	5,825	13,330	14,560	--
French West Africa	[8] 1,194	[3] 2,010	[16] 1,000	[16] 900	[16] 930	[8] 890	[17] 737
Madagascar	3,440	4,370	3,300	2,755	2,755	3,300	--
Mozambique	[14] 1,750	[3] 3,140	[14] 4,863	[14] 2,596	[14] 2,464	--	--
Angola	[8] 4,674	[8] 5,063	([18])	[8] 5,178	[8] 5,768	[14] 6,279	--
Union of South Africa	--	--	450	4,000	7,500	20,000	--
Estimated total[6]	13,915	28,345	37,965	45,635	57,035	67,255	60,495
Estimated world total	474,195	492,245	527,720	535,425	530,670	561,790	559,470

[1] Preliminary.
[2] For the years shown, no commercial production other than for seed except in 1951-1954.
[3] Average of less than 5 years.
[4] United States imports of beans.
[5] Estimate based on United States imports January-October.
[6] Includes estimates for the above countries for which data are not available and for minor producing countries.
[7] 1948 only.
[8] Exports of castorbeans.
[9] Prior to 1945 figures for India include Pakistan.
[10] Estimates for the pure crop only; reliable data for the interplanted crop not available.
[11] Beginning with 1947 figures are for South Korea only.
[12] 1946 only.
[13] United States imports of beans and oil, bean basis.
[14] Exports of beans and oil, bean basis.
[15] Quantity marketed.
[16] Commercial production.
[17] Bean exports January-August.
[18] Exports amounted to 14,019 tons but represented a carryover from previous crops rather than a larger crop.

Prepared by Foreign Agricultural Service. Estimates based on official statistics of foreign governments, reports of Agricultural Attachés and other United States representatives abroad, results of research, and other information.

TABLE 32.--Relationship between oil content of castorbeans and quantity of cracked and broken beans, by variety and hulling center, 1952 and 1953 crops

Variety and hulling center	Crop	Degree of relationship[1]	Variation explained[2]	Change in oil content[3]
Conner:			*Percent*	*Percent*
Jourdanton, Tex........	1953	0.80	63	0.88
Henryetta, Okla........	1953	.77	60	.82
Jewett, Tex............	1952	.77	59	1.01
Bonham, Tex............	1952	.74	55	.67
Gilmer, Tex............	1953	.70	49	.66
Carbon, Tex............	1952	.69	48	.49
San Antonio, Tex.......	1952	.64	41	1.17
Athens, Tex............	1953	.57	33	1.25
Giddings, Tex..........	1953	.56	31	.36
Anadarko, Okla.........	1952	.53	28	.75
Grand Saline, Tex......	1953	.42	18	.49
Keller, Tex............	1952	.41	17	.33
Cross Plains, Tex......	1953	.39	15	.47
Chico, Tex.............	1952	.38	15	.51
Sulphur Springs, Tex...	1953	.34	11	.25
Mt. Pleasant, Tex......	1953	.32	10	.40
Holdenville, Okla......	1953	.31	9	.22
Hillsboro, Tex.........	1953	.19	4	.08
Atlanta, Tex...........	1953	.16	2	.40
Median..............		0.53	28	[4] .49
Baker 1:				
Edinburg, Tex..........	1952	0.50	25	.42
Crystal City, Tex......	1953	.46	21	.48
Hale Center, Tex.......	1952	.38	14	.48
Ralls, Tex.............	1952	.37	14	.26
San Angelo, Tex........	1952	.29	8	.16
San Benito, Tex........	1952	.22	5	.27
Cimarron:				
Altus, Okla............	1952	.70	49	1.36
Plainview, Tex.........	1953	.28	8	.39
U. S. 74:				
Sulphur Springs, Tex...	1953	.63	40	.64
Hugo, Okla.............	1953	0.40	16	.84

[1] Coefficient of correlation: Degree of relationship between the two variables. Perfect relationship between oil content and cracked and broken beans would be 1.

[2] Coefficient of determination: Percentage to which the variance in oil content is determined by cracked and broken beans.

[3] Coefficient of regression: Change in oil content with each 1 percent change in cracked and broken beans.

[4] Represents the median change from an array of the regression coefficients.

Of the 70 hulling centers for which analysis of oil content and cracked and broken castorbeans was made, scatter diagrams for 29 seemed to show some consistency of interrelationship. Interrelationship in the remaining 41 appeared to be essentially zero. In most of the 29, the number of observations was too small to give "statistical significance." Taken together, however, their appreciable consistency lends some credence to the suggestion of a relationship.

TABLE 33.--Relationship between quantity of cracked and broken castorbeans and moisture content, by variety and hulling center, 1952 and 1953 crops

Variety and hulling center	Crop	Degree of relationship[1]	Variation explained[2]	Change in oil content[3]
Conner:			*Percent*	*Percent*
Jewett, Tex............	1952	0.72	52	4.31
Holdenville, Okla......	1953	.64	42	3.31
Bonham, Tex............	1952	.53	28	1.05
Sulphur Springs, Tex...	1953	.50	25	1.47
Hillsboro, Tex.........	1953	.37	14	1.82
Llano, Tex.............	1953	.19	4	.17
Grand Saline, Tex......	1952	.13	2	.54
U. S. 74:				
Rush Springs, Okla.....	1953	.73	53	4.12
Sulphur Springs, Tex...	1953	.33	11	.27
Baker 1:				
Ralls, Tex.............	1952	.65	42	2.14
Crystal City, Tex......	1953	.50	25	1.22
Hale Center, Tex.......	1952	.38	14	.76
Baker 7:				
Hereford, Tex..........	1952	.57	32	4.50
Cimarron:				
Plainview, Tex.........	1953	.15	2	.46
Median..............		.50	25	[4] 1.47

[1] Coefficient of correlation: Degree of relationship between the two variables. Perfect relationship between cracked and broken beans and moisture would be 1.

[2] Coefficient of determination: Percentage to which the variance in cracked and broken beans is determined by moisture.

[3] Coefficient of regression: Change in cracked and broken beans associated with a unit change in moisture.

[4] Represents the median change from an array of the regression coefficients.

Of the 70 hulling centers for which analysis of cracked and broken castorbeans and moisture content was made, scatter diagrams seemed to show some consistency of interrelationship for 14. Interrelationship in the remaining 56 appeared to be essentially zero. In most of the 14, the number of observations was too small to give "statistical significance." Taken together, however, their appreciable consistency lends some credence to the suggestion of a relationship.

TABLE 34.--Relationship between quantity of unhulled castorbeans and moisture content, by variety and hulling center, 1952 and 1953 crops

Variety and hulling center	Crop	Degree of relationship[1]	Variation explained[2]	Change in oil content[3]
Conner:			*Percent*	*Percent*
San Antonio, Tex.......	1952	.8[illegible]	72	.63
Gilmer, Tex............	1953	.7[illegible]	48	1.30
Brownwood, Tex.........	1953	.6[illegible]	41	1.47
Clarksville, Tex.......	1953	.5[illegible]	29	3.49
Cross Plains, Tex......	1953	.41	17	.58
Holdenville, Okla......	1953	.38	15	1.40
Hillsboro, Tex.........	1953	.32	10	1.05
Giddings, Tex..........	1953	.27	8	1.09
Athens, Tex............	1953	.05	0	.20
Baker 1:				
Crystal City, Tex......	1953	.70	50	5.83
Ralls, Tex.............	1952	.59	35	1.93
Friona, Tex............	1952	.23	6	1.04
Cimarron:				
Altus, Okla............	1952	.25	6	2.03
Baker 7:				
Hereford, Tex..........	1952	.65	42	9.48
Median..............		.48	23	[4] 1.35

[1] Coefficient of correlation: Degree of relationship between the two variables. Perfect relationship between unhulled castorbeans and moisture would be 1.

[2] Coefficient of determination: Percentage to which the variance in unhulled beans is determined by moisture.

[3] Coefficient of regression: Change in unhulled beans associated with a unit change in moisture.

[4] Represents the median change from an array of the regression coefficients.

See paragraph below table 33.

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